

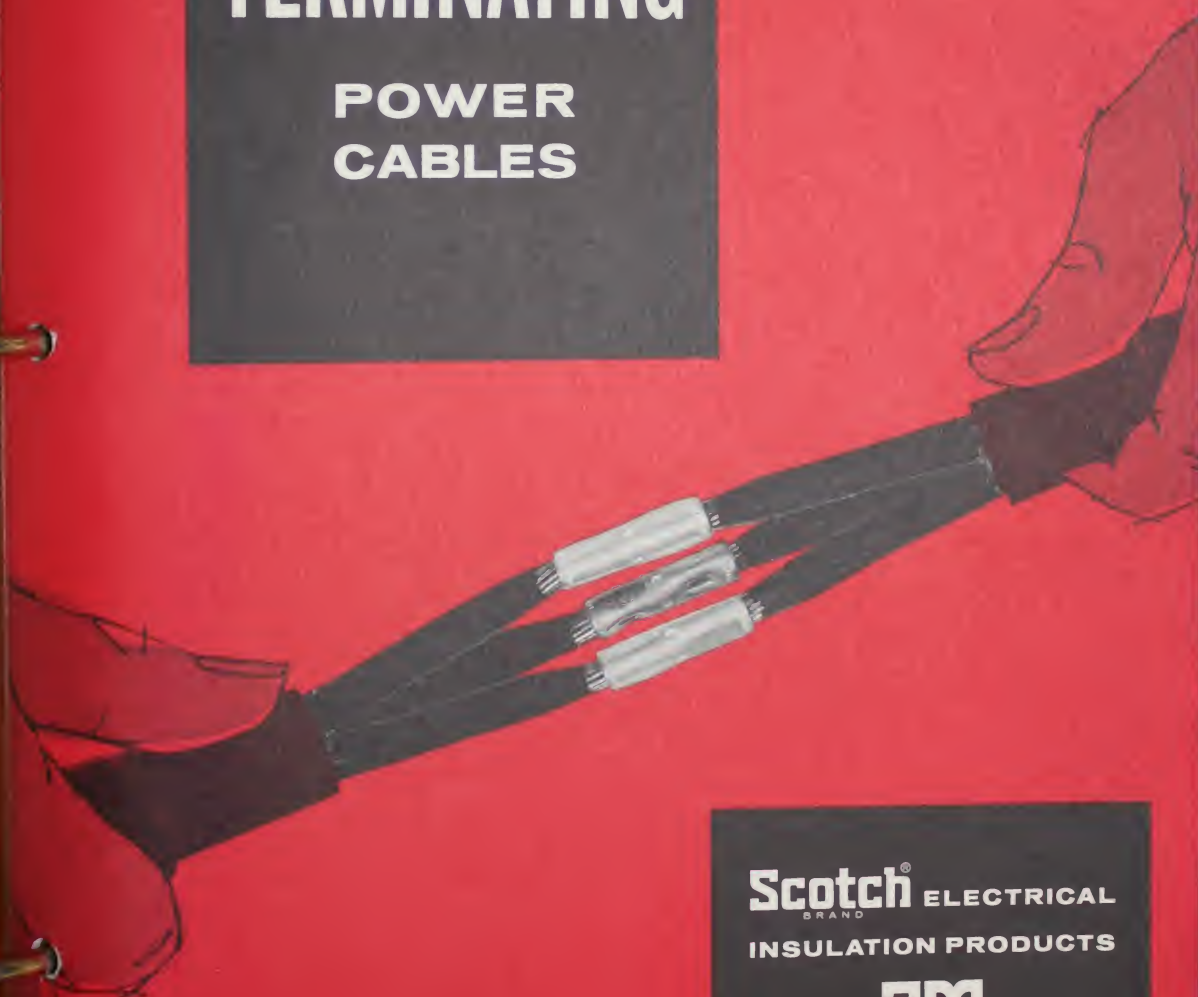


JAMES J. KIERAN

ELECTRICAL PRODUCTS DIVISION

MONTREAL, P. Q.

and TERMINATING POWER CABLES



Scotch[®] ELECTRICAL
BRAND
INSULATION PRODUCTS





We are anxious for you to know more about "SCOTCH" Brand Electrical Products, particularly those materials designed for the electric power industry. Many people, from all corners of the world, have contributed to this book either by helpful suggestions or know-how. We hope that you will find the brief resume of each product helpful and that the tried and proven methods, as well as the new techniques, find a place in your system.

The data we supply here is fundamental, of course, but our distributors and field engineers are ready to work with you and provide additional information on products and applications.

The photograph of the 3M Electrical Products Laboratory represents part of your guarantee—a guarantee of exceptional quality and service each time you specify or use one of 3M's Electrical Products.

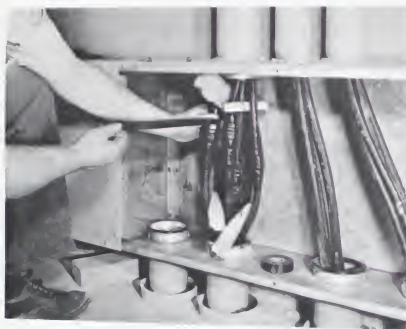
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NO. 33 A RELIABLE AND DEPENDABLE SPlicing TOOL!

"Scotch" Brand Electrical Tape No. 33 is a tough vinyl plastic tape well known to men who work with electricity throughout the world. Its excellent adhesive system does not break down or get brittle with aging . . . keeps the tape wrapped tight long after most tapes fail. No. 33 combines excellent mechanical strength, copper corrosion resistance and superior weathering characteristics with thinness and high conformability. It resists acid, oil and abrasion.

TYPICAL APPLICATIONS

- Insulating and protecting feeder cables
- Insulating and sealing motor leads
- Providing insulation and weather protection on outdoor splices

Jointers use No. 33 as an *extra tool* for many difficult insulating and sealing jobs quickly and easily. It is the tape that "feels" right to the men who use it.

NO. 88 FOR COLD WEATHER APPLICATIONS

"Scotch" Brand Electrical Tape No. 88 has been developed for easy application in cold weather. Temperatures down to 0°F present no problem, yet it retains its toughness and conformability even in warm weather.

NO. 99 FOR SPECIAL HIGH TEMPERATURE LOCATIONS

"Scotch" Brand Electrical Tape No. 99 combines high temperature stability—to 105°C (220°F) continuous—with superior resistance to oil splash.

TYPICAL APPLICATIONS

High temperature applications up to 105°C; connections and splices to oil-filled equipment.

PROPERTIES

Tape No.	Color	Over-All Thickness	Tensile Strength Lbs./In.	Elong. At Break	Adhesion Oz./In. Width	Insulation Resistance Meg-Ohms	Electric Strength	Corrosion Factor
33	Black	.007"	20	175%	30	$> 1 \times 10^4$	9800 v.	1.0
88	Black	.0085"	20	250%	20	$> 1 \times 10^4$	10,000 v.	1.0
99	Black	.0085"	20	250%	16	$> 1 \times 10^4$	9350 v.	1.0

NO. 22 HEAVY DUTY

This heavy duty splicing tape has all the desirable properties of general purpose "Scotch" No. 33; additionally its extra thickness provides increased mechanical strength, abrasion resistance and weathering characteristics.

Where more severe abrasion problems are encountered, thicker "Scotch" Brand Electrical Tape No. 21 is recommended.

TYPICAL APPLICATIONS

- Repair and protect cable sheath
- Insulate and protect bus bars, transformer leads and circuit breaker connections

Scotchfil
BRAND

ELECTRICAL INSULATION PUTTY

This is a non-corrosive synthetic rubber insulating compound in tape form. Its extra thickness ($\frac{1}{8}$ " or 3.17 mm) and width ($1\frac{1}{2}$ " or 38.1 mm) make "Scotchfil" the most economical, speedy and easy method of sealing and padding irregular shapes and filling voids.

"Scotchfil" has excellent molding characteristics and applies cleanly without waste. After application, it forms a homogenous mass around any irregular shape that will not dry out, soften, become brittle or hard. It bonds only to itself, making re-entry easy. "Scotch" Brand No. 33 or 22 Electrical Tape completes the outer protection and electrical requirements of the splice.

TYPICAL APPLICATION

- To insulate irregularly shaped splice and terminal connectors and provide a smooth taping base.

NO. 27 HEAT RESISTANT GLASS CLOTH

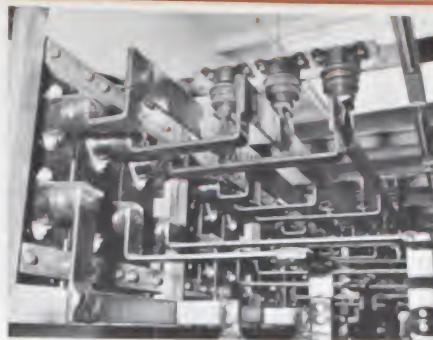
"Scotch" Brand Electrical Tape No. 27 is used where operating temperatures require extra cable protection. This glass cloth tape with thermosetting adhesive resists Class B (130°C) temperatures and flame, while its thermosetting adhesive assures a fast, permanent bond.

TYPICAL APPLICATION

- Splicing and over-wrapping heat resistant wires and cables such as near a blast furnace.

PROPERTIES

Type of Backing	Thickness	Tensile Strength Lbs./In.	Elongation % at Break	Adhesion Oz./In.	Insulation Resistance Megohms	Electric Strength Volts	Electrolytic Corrosion
Glass Cloth	.0065	150	5	40	600	1250	.95



PROPERTIES

Tape Number	Color	Over-All Thickness	Tensile Strength Lbs./In.	Elong. At Break	Adhesion Oz./In. Width	Insulation Resistance Meg-Ohms	Electric Strength	Corrosion Factor
22	Black	.010"	30	250%	30	$>1 \times 10^6$	11,500 v.	1.0
21	Black	.020"	55	350%	25	$>1 \times 10^6$	19,000 v.	1.0



Color	Over-All Thickness	Electric Strength	Insulation Resistance Meg-Ohms	Corrosion Factor	Cu Corrosion	Silver Corrosion	H ₂ O Absorption
Black	$\frac{1}{8}$ " (3.17mm)	400V per mil	$>1 \times 10^3$	1.0	none	none	0.4%



Scotchlok[®] ELECTRICAL CONNECTORS WITH "LIVE" SPRING ACTION

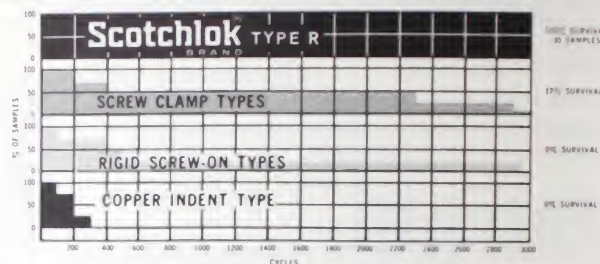
BRAND

The expandable spring principle of "Scotchlok" Brand connectors hold the conductors under constant tension . . . assures positive mechanical and electrical connections under thermal and mechanical stresses.

"Scotchlok" Brand Connectors are commonly used for a variety of *low-voltage* applications—lighting fixture connections, household electrical circuits and motor lead connections.

THIS IS WHAT "LIVE SPRING" ACTION MEANS—ELECTRICALLY!

CONNECTOR CURRENT CYCLING TEST



THIS IS WHAT "LIVE SPRING" ACTION MEANS—PHYSICALLY!

ORDINARY CONNECTORS



AS MADE, the connector body is rigid, non-yielding. Conductors are crushed to conform to connector dimensions.

UNDER HEAT, connector body is stretched and strained by the expanding conductors.

WHEN COLD, the cluster of conductors shrinks away from the now-stretched connector; connection pressure decreases and splice efficiency degenerates.

Scotchlok[®] CONNECTORS

BRAND



AS MADE, the "live spring" action surrounds the conductors, assuming their shape.

UNDER HEAT, the "live spring" in the "SCOTCH-LOK" Connector gives with the conductor expansion; maintains its steady, firm grip.

WHEN COLD, the "live spring" in the "SCOTCH-LOK" Connector contracts with the shrinking conductors; keeps the splice pressure constant and maintains full splice efficiency!

WIRE RANGES

INSULATED	WIRE SIZES		UNINSULATED
	AWG	EUROPEAN	
Type Y	18-12	(0.8-3.3mm ²)	Type S
Type R	16-10	(1.3-5.3mm ²)	Type M
Type B	12-6	(3.3-14mm ²)	Type L
	8-2	(8.4-35mm ²)	Type D



TYPE B: For heavy-duty industrial applications. 6 to 12 AWG solid and stranded. UL listed as a pressure connector—rated at 75°C. for use on Cu to Cu or Al to Al wire



Type R: For general circuit connections. Wire range from No. 10 to 16 AWG—solid and stranded. UL listed as a pressure connector—rated at 105°C. for use on Cu to Cu or Al to Al wire



Type Y: For fixtures. Handles wire range from No. 12 to 18 AWG, solid or stranded. UL listed as a pressure and as a fixture connector—rated at 105°C.

The uninsulated "Scotchloks" Types S, L, M and D require a wrap of "Scotch" No. 33 to complete the job.

Scotch® BRAND

NO. 23
ELECTRICAL TAPE



"Scotch" Brand Electrical Tape No. 23 is used on high voltage service and is corona resistant and instant fusing. Easy to use. No. 23 provides permanent insulation on all high voltage rubber, synthetic and plastic cable splices and terminations. It retains its important corona properties during emergency over-load and short circuit loading. The self-bonding feature eliminates the need for heated splice rollers and cements. Unlike other self-fusing electrical tapes, variation in elongation during the wrapping operation does not affect the corona or ozone resistance of "Scotch" Electrical Tape No. 23.

TYPICAL APPLICATIONS

- Termination stress cones and splices.

PROPERTIES

Overall Thickness in Mils	Fusion	Ozone Resistance	Liner Removal	Effect of Heat (400 Hrs. @ 100°C)
.030	Excellent	Excellent	OK	OK
Flexibility After Heat Aging (200 Hrs. @ 100°C)	Cold Bend (1 Hr. @ -55°C)	Insulation Resistance Megohms	Electric Strength Volts/mil	Electrolytic Corrosion
No degradation	OK	$> 1 \times 10^4$	600	1.0

NO. 13 SEMI-CONDUCTING TAPE

Scotch" Brand Electrical *Semi-Conducting* Tape No. 13 is a self-fusing rubber base tape for electrical cable splices and terminations. Its primary function is to "soften" or reduce the concentrated electrical stresses which exist around connectors, terminal lugs and metallic shielding termination points. This semi-conducting tape is specially packaged to insure against accidental misuse—it has a "caution" marked red liner and is supplied on a unique, easily distinguishable oblong roll.

Scotch" No. 13 is not oil resistant and must not be used on varnished cambric or paper cables.

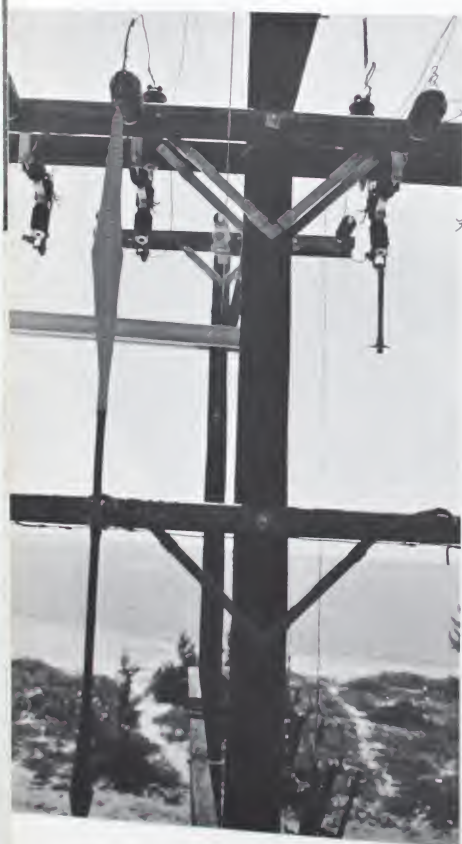
TYPICAL APPLICATIONS:

- To eliminate corona "noise" in high voltage switchgear.
- On 90° C rated cables.
- To eliminate the need for solder sweated connectors by allowing the use of indent type connectors when splicing high voltage rubber or thermoplastic cables . . . safer and faster.

PROPERTIES

Elongation	Tensile Strength	Conductance	Thickness
400%	5 pounds/inch width	2000 Ohms/Square	30 mils





NO. 24 ELECTRICAL SHIELDING TAPE

"Scotch" Brand Electrical Shielding Tape No. 24 is a 1" wide tinned copper, wire braid for use as an *electrostatic* shield across splices or as the conductive surface of stress relief cones. It is normally spiral wrapped with one serving, half-lapped with tension to maintain a $\frac{3}{4}$ " width. The shielding tape is then attached to the cable shielding by soldering (this procedure is covered in the drawings on pages 7 and 8).

To assure the current carrying capacity of the cable shield across the splice or to an external ground, we recommend a jumper wire or strap of sufficient size. This wire, or strap, is used in conjunction with "Scotch" No. 24.

NO. 70 CLASS H SPLICING TAPE

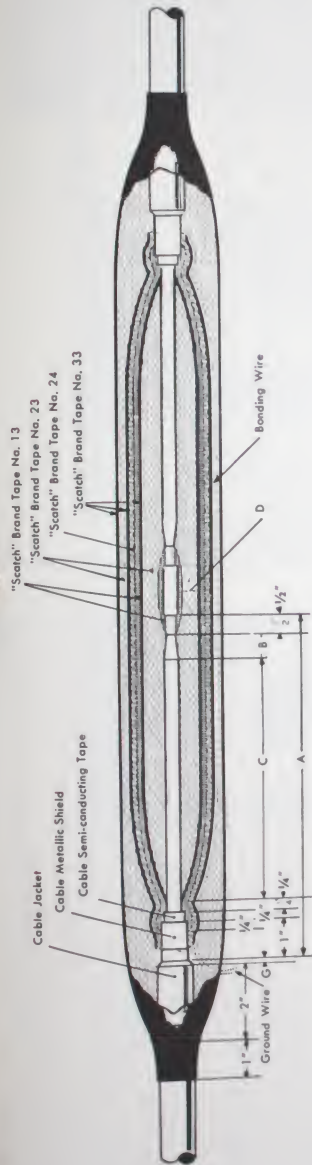
"Scotch" Brand Electrical Tape No. 70 is a fully cured, inorganic, silicone rubber tape. It employs a thermosetting adhesive. This high temperature (Class H) tape is compounded to be compatible with silicone cables. Being an unsupported silicone rubber, No. 70 has excellent conformance for easy wrapping. It has excellent electric strength, ozone resistance and weathering characteristics. The silicone rubber surface of No. 70 resists long-term exposure to arc tracking and external corona discharge.

TYPICAL APPLICATION

- As an overwrap on high voltage terminations to eliminate arc-tracking damage. (Refer to drawing on page 8.)

PROPERTIES

Overall Thickness in Mils	Tensile Strength Lbs./In.	Elongation % at Break	Adhesion Oz./In.	Temperature Classification
.015	11	600	14	H (180°C.)
Electric Strength Volts	Insulation Resistance Megohms	Arc Resistance Seconds	Electrolytic Corrosion	Copper Corrosion
10500	$>1 \times 10^4$	135	1.0	None



RECOMMENDED GENERAL PROCEDURE*

1. Train cable in final position and cut to proper length so cable ends will butt squarely. Scrape the cable jacket for 3 inches beyond dimension A to remove all wax, cable pulling compound and make a good surface to which the tape will adhere and keep moisture out of the joint.
2. Remove cable jacket from ends to be spliced for a distance "A" plus one half the length of connector to be used. Do not make a ring cut through the jacket because of the danger of cutting the metallic shielding and insulation. Remove the cable metallic shielding and semi-conducting material so they extend one inch and 1 1/4 inches respectively beyond the cable jacket. The metallic shielding should be tacked in place with solder. If the splice is to be grounded, solder a ground strap onto the cable metallic shielding as shown in the drawing. Use a ground strap having at least the same ampacity as the shield. If a stranded ground is used, provide a solder block to prevent moisture penetration.
3. Remove the cable insulation from the end of each conductor for a distance of 1/2 inch plus one half the length of the connector. BE CAREFUL NOT TO NICK THE CONDUCTOR.
4. Remove all traces of semi-conducting material from the exposed cable insulation. This may be done by scraping thoroughly with a knife, sandpaper or rasp. Finally clean the surface with a clean cloth. DO NOT CUT INTO THE CABLE INSULATION.
5. Pencil the insulation at each end smoothly for a distance equal to dimension "B". Sandpaper or a rasp may be used to buff tapers to insure a smooth surface so that no voids will remain after the joint is insulated. EMERY PAPER SHOULD NOT BE USED FOR IT CONTAINS METALLIC PARTICLES.
6. Taper cable jacket at each end smoothly for a distance equal to "C". Sandpaper may be used to buff the taper.
7. Join the conductors with the connector. Follow connector manufacturer's directions; remember to use an anti-oxidant paste for aluminum conductors. When using a solder sweated connector, protect the cable insulation with temporary wraps of cotton tape. DO NOT USE ACID CORE SOLDER OR ACID FLUX. Only specially designed connectors may be used to join copper and aluminum conductors.
8. Fill any possible indentations in the connector with "Scotch" Semi-Conducting Tape #13 then tape over the semi-conducting strands on the conductor and the exposed conductor between the connector and penciled cable insulation with semi-conducting tape. Smoothly overwrap the entire distance between the tips of the penciled cables with one half lapped layer of semi-conducting tape. DO NOT ALLOW THE SEMI-CONDUCTING TAPE TO OVERLAP THE CABLE INSULATION. DO NOT ALLOW ANY SEMI-CONDUCTING STRANDS TO STICK UP.
9. Tape over the semi-conducting tape and all exposed insulation up to within 1/4" of the cable semi-conducting tape, with "Scotch" High Voltage Splicing Tape #23. Wrap the splicing tape half-lapped in successive level wound layers, until the thickness over the semi-

conducting tape is equal to dimension "D". When applying the splicing tape, stretch it to conform. Highly elongate the splicing tape in the connector area to prevent entrapment of air. Throughout the rest of the taping, less elongation may be used except near the ends of the splice where the splicing tape should once again be greatly elongated to feather the insulation near the cable semi-conducting tape. The outside surface should taper gradually along distance "C" reaching the maximum diameter at the top of the penciled insulation.

10. Wrap one layer of "Scotch" Vinyl Electrical Tape #33 over the splicing tape. DO NOT OVERWRAP ANY STRANDS OF THE CABLE SEMI-CONDUCTING MATERIAL. Wrap the vinyl tape half-lapped, stretching the 3/4 inch tape to reduce its width to 1/2 inch.

11. Wrap one half-lapped layer of semi-conducting tape #13 over the vinyl tape, extending over the cable semi-conducting material and onto the cable shield one-fourth inch at both ends.

12. Wrap a layer of "Scotch" Tinned Copper Shielding Tape #24 over the semi-conducting tape with 1/2 to 3/4 lap, overlapping the cable metallic shielding at each end of the splice. This layer very tight to flatten and confine the shielding braid.

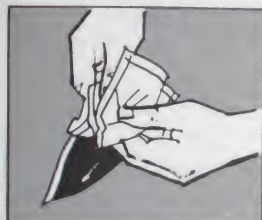
13. Attach the bonding wire as shown in the drawing, soldering it to the cable metallic shielding at each end. Use a wire having at least the same ampacity as the shield.

14. Wrap splicing tape #23 for about 1" along ground strap. Bend ground strap back and wrap four successive half-lapped layers of splicing tape over the entire splice and onto the cable jacket for 2". These layers should be put on using about 10% elongation.

15. Cover the entire splice with two layers of vinyl tape #33 half lapped, extending along cable jacket for 1 inch on each end. Tape should be stretched to reduce its 3/4" width to 1/2" to insure good conformance.

*Because of the great variety of cable types we suggest you contact the International Division 3M Company, P. O. Box 3800, St. Paul 1, Minnesota, U.S.A., for recommended dimensions of A, B, C, D and G.

INLINE TAPE SPLICE, SOLID SYNTHETIC TAPE SHIELDED CABLE



A.

Take a firm pinch on EACH of the flat sides of the "UNIPAK" container near the center barrier. Pull bag sides apart and roll thumbs through the barrier.



B.

Alternately squeeze ends of the "UNIPAK" forcing contents rapidly back and forth.



C.

Strip contents from corners with thumb and forefinger. Mix until color is uniform (30 to 40 vigorous squeezes).

Scotchcast[®] RESIN NO. 4

BRAND

IN THE UNIQUE "UNIPAK" CONTAINER

This is a two-part epoxy system packaged in an easy-to-use "Unipak" Container, pre-measured to assure an *exact* mixing ratio. "Scotchcast" Brand Resin No. 4 is the heart of two splicing methods... the "Scotchcast" Kit method and the "Scotchcast" Resin Pressure System, both covered in the next few pages.

"Scotchcast" Brand Resin No. 4 is a completely cold system, curing to a semi-rigid mass, by chemical reaction of the resin and the hardener—no heat is required: No measuring device, mixing container, spoon or thermometer are needed. The big advantage of this system is that it provides the superior sealing and insulating characteristics of epoxy resin.

The two-part resin is kept separated in the "Unipak" by a film divider. For use, the divider is opened (see drawing at left) and the resin and hardener are mixed. Because the "Unipak" is closed during the mixing operation, air, moisture or other contaminants cannot be introduced, which is common in conventional "measure and mix" systems.

"Scotchcast" No. 4 is thermosetting and will not melt or run. It has exceptional adhesion qualities and compatibility with all common wire and cable insulators and sheaths. Fast bonding characteristics and slight shrinkage assure complete moisture protection.

AVERAGE PROPERTIES

Electrical Strength	ASTM-D-149-44 volts./mil 1/4" sample	400
Dielectric Constant	ASTM-D-150-54T K, 60 cycles 50% RH 30°C 60°C 70°C	3.37 3.77 4.40
Dissipation Factor	ASTM-D-154-54T D, 60 cycles 50% RH 30°C 60°C 70°C	.0038 .023 .058
Volume Resistivity	ASTM-D-257-54T Ohm-Cm 50% RH 30°C 60°C 70°C	2.8×10^{11} 1.7×10^{11} 4.8×10^{10}
Water Absorption	ASTM-D-570-42 %, 24 hr. 23°C 53°C	.193 .62
Tensile Strength	ASTM-D-638-42T PSI	8,070 2.4
Elongation	%	1.0
Electrolytic Corrosion	Ratio D-1000	1/2 to 1 1/2
Shrinkage During Cure	%	Excellent
Water Resistance		Excellent
Oil Resistance		Excellent
Solvent Resistance, Aromatic or Straight Chain		Insoluble Good
Weather Resistance		
Coefficient of Expansion inches./inch./degree C	ASTM-D-696-44	1.5×10^{-4}

Scotchcast[®] SPLICING KITS

BRAND

All materials needed for insulating and sealing inline and wye cable splices are included in these kits. These kits use "Scotchcast" Brand Resin No. 4 as the insulator which is poured into ready-to-use transparent plastic molds. Each kit contains complete instructions for preparation of the cable, assembly of the mold and pouring the resin. You can be sure of uniformly dependable splices which are moisture proof, impact resistant and electrically sound in varied climatic conditions.

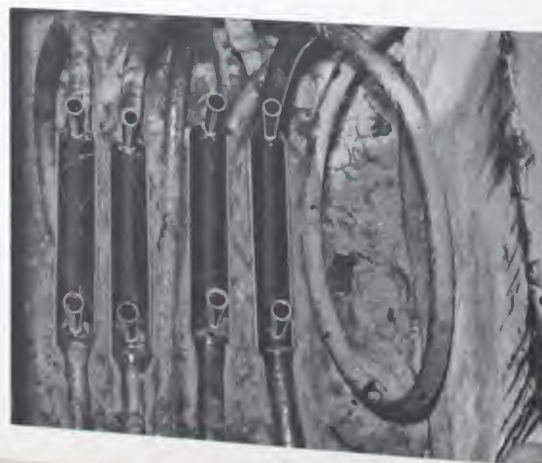
Joints made with "Scotchcast" Splicing Kits are especially effective for either exposed or underground, including direct burial, locations. They are used for *non-shielded* cables only.

A variety of "Scotchcast" Splicing Kits are available: The 82-A series for inline splices (4 sizes) and the 82-B1 and 90-B1 kits for wye or tap joints.

RANGE OF CABLE O.D.

	Feeder		Wye	
	Min.	Max.	Min.	Max.
82-A	1/4" (6.35 mm)	3/4" (19.1 mm)
82-A1	1/4" (6.35 mm)	5/8" (15.9 mm)
82-A2	3/8" (15.9 mm)	1" (25.4 mm)
82-A3	1" (25.4 mm)	1 7/8" (36.5 mm)
82-B1	1/4" (6.35 mm)	3/8" (15.9 mm)	1/4" (6.35 mm)	3/8" (15.9 mm)
90-B1	1/2" (12.7 mm)	1 3/4" (20.6 mm)	3/8" (9.51 mm)	1 3/8" (20.6 mm)

*8.7 KV PHASE TO PHASE



82-A1

82-A2

82-A3



82-B1

90-B1





Scotchcast[®] TERMINATION BRAND KITS

These kits contain a full complement of accessories to terminate any single conductor cable (paper, rubber, or synthetic insulated), rated to 20 KV three phase grounded neutral service and under, with primary insulation O.D. range from .62" (15.7 mm) to 1.15" (29.3 mm).

"Scotchcast" Termination Kits are engineered for optimum stress relief, installation simplification and universality which will improve the job quality . . . save time and money on each application. Each kit contains all necessary components for the job (except the terminal lug), "Scotchcast" Brand Resin No. 14 in the "Unipak" container, pre-formed stress relief cone, ground strap, transparent mold bodies, terminal shields and a mounting bracket; also complete instructions for preparation of the cable, assembly of the mold and injecting the resin.

The 83A series is designed for *outdoor* use where weather or conductive contaminants create problems. The 83B series is used *indoors* and where weather or conductive contaminants are not a factor.

The high reliability of "Scotchcast" Brand Termination Kits 83-A3 and 83-B3 in a variety of field applications has created a demand for a larger version of each. About to be released are the 83-A4 and 83-B4 Kits, both for use with an insulation diameter range of 1.15" to 1.54" (29.3mm to 37.6mm); maximum sheath diameter, 2.14" (54.4mm).



Scotchcast[®] TERMINATION BRAND KITS (continued)

The completeness, design and universality of the 83 Series Termination Kits make installation simple, rapid and economical. The self-cleaning outer face, the real working area of a termination, consists of a transparent split mold in the stress cone area, and either threaded termination shields in Kit No. 83A-3 (weather exposed) or a threaded tube in Kit No. 83B-3 (weather protected). Excellent track resistance. Check-fit design insures optimum quality layout and speeds installation.

The pre-formed stress relief cone insures a smooth transition of stress in the critical shield termination area. Pre-formed, the stress cone slides over the primary insulation and onto the shield in seconds—no more critical wrapping and measuring; it is designed to be right.

Scotchcast[®] SINGLE CONDUCTOR BRAND STRESS CONE KIT

The "Scotchcast" Brand Stress Cone Kit No. 83-B1 is for use on concentric neutral underground residential distribution (non-metallic shielded) cables. It provides an easy, economical and effective method of terminating the conductive sheath and a positive moisture seal of the critical stress relief area. The 83-B1 is designed for cables where the nominal voltage rating (phase to phase) does not exceed 15 KV and for pad mounted transformers where moisture, contamination and ultra-violet effects are not prevalent. Where it is desired to protect the primary insulation from tracking and ultra-violet exposure, we recommend that the tail be covered with "Scotch" Brand Electrical Tape No. 70. Each kit contains sufficient parts to seal the stress relief area of two cables . . . insulation diameter range, 21/32" through 7/8"; O.D. range, 27/32" through 1-1/16", not including external concentric connectors.

THREE CONDUCTOR

Three conductor cables using "Scotch" principles and easy-to-use attempted to develop additional information and from 3M Company.

1. The photo and sketch of terminating a three conductor cable using impregnated paper.

By joining the cables—insulated user is provided with

1. Solid type insulator cleaner and easier

2. An oil stop material

3. Highly reliable compound filling may be used compound filling

11. Three conductor cable terminated simply the crotch and tree cable. In the case of phase (over the shield) Electrical Tape be

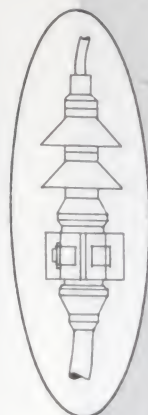
Note: The transition shown below, or in a concrete conduit.

3 Conductor
Paper Insulated Cable

Non-Shielded Cable Joint on page 23—however Joint thru use of "Scotch" wire of at least 13.3mm (1/2")

THREE CONDUCTOR CABLE TERMINATIONS

Three conductor cables may be terminated in a variety of ways using "Scotchcast" Brand Resin Pressure Method principles and easy-to-use 83 Series Termination Kits. We have attempted to describe two typical methods on this page; additional information and detailed instructions may be obtained from 3M Company or the 3M representative in your area.



"Scotch" Brand Termination Kits described on pages 11 & 12



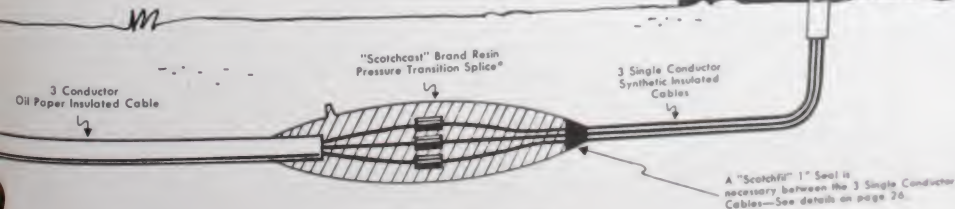
1. Solid type insulations (PVC, Polyethylene, Butyl) are cleaner and easier to work with and are *weatherproof*.

2. An *oil stop* may be made at the transition joint.

3. Highly reliable, *void-free* epoxy resin filled terminations may be used on each conductor in place of hot-compound filled trifurcation boxes.

II. Three conductor cables with solid type insulation may be terminated simply by spreading the cores, moisture-sealing the crotch and treating each phase as a single conductor cable. In the case of individually shielded conductors, these may also be terminated in the same way by wrapping each phase (over the shielding) with "Scotch" Brand No. 22 Electrical Tape between the crotch seal and termination.

Note: The transition splice maybe made below ground, as shown below, or in a vertical position, above ground inside the concrete conduit.



*Non-Shielded Cable Joints should be constructed according to the drawing on page 23—however Joints in shielded cable must provide for shield continuity thru use of "Scotch" Brand Shielding Tape No. 24 and a jumper wire of at least 13.3mm² (#6 awg) as shown on page 22.



NOTE: The demand for Splicing and Terminating Kits of the shape and general dimension shown on this page originated within the European market. They are manufactured only by 3M Germany and all orders and requests for technical information should be directed to:

3M Company mbH
Export Department
2102 Hamburg—Wilhelmsburg
Georg-Wilhelm-Strasse 182-185
Germany



Scotchcast [®] BRAND SPLICING KITS (bulged mold design)	Range of Cable O.D.				Packing	
	Feeder		Wye		Per Box	Per Ctn.
	Min	Max	Min	Max		
92-A1 (inline)	3/8" 10mm	1" 25mm	—	—	1	10
92-A2 (inline)	3/8" 15mm	1 3/8" 35mm	—	—	1	10
92-A3 (inline)	1" 25mm	1 3/8" 45mm	—	—	1	10
92-A4 (inline)	1 3/8" 40mm	2 1/4" 55mm	—	—	1	5
92-T2 (T-splice) Full cartons only	3/8" 15mm	1 1/4" 30mm	3/8" 10mm	1" 25mm	1	10

Scotchcast [®] BRAND TERMINATION KITS	Range of Cable O.D.		Packing	
	Min	Max	Per Box	Per Ctn.
92-S1 (termination)	3/8" 10mm	3/4" 20mm	1	10
92-S2 (termination)	3/4" 20mm	1 1/4" 30mm	1	10
92-S3 (termination)	1 1/4" 30mm	2" 50mm	1	10
92-S6 (termination)	2" 50mm	3 3/4" 90mm	1	5

Scot

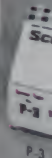
RESIN PRESSURE

The maximum reliability with the "Scotchcast" thickness, shunt and fully controlled resin. The finished dimension is much smaller than conventional protective jacketing. Unlike polyurethane compounds, "Scotchcast" is not applied until full cure.

"Scotchcast" Brand synthetic and lead sheath insulation. Similarly, unshielded cables or

building the "Scotchcast" following pages illustrate necessary for immediately below.

"Scotch Brand" Electrical Tape No. 1



P-3

Scotchcast

BRAND

RESIN PRESSURE METHOD

The maximum reliability of an epoxy resin joint is easily achieved with the "Scotchcast" Brand Resin Pressure Method. Insulation thickness, sheath and armor replacement and linear dimensions are easily controlled regardless of size or configuration of the splice. The finished dimensions of "Scotchcast" Resin Pressure joints are much smaller than conventional methods because the resin serves as its own protective jacket . . . no additional mechanical protection is necessary. Unlike pouring, waiting and topping off with bitumastic compounds, "Scotchcast" Resin is injected, under pressure, into the joint until full and the job is done!

"Scotchcast" Brand Epoxy Resin is compatible with all rubber, synthetic and lead sheath cables, regardless of the type of primary insulation. Similarly, it may be used on all varieties of shielded or unshielded cables or for oil-stopped joints.

Building the "Scotchcast" Resin Pressure "mold" is easy and the following pages illustrate the procedure for a common joint. The parts necessary for building the Resin Pressure Splice are shown immediately below.



"Scotch Brand"
Electrical Tape No. 33

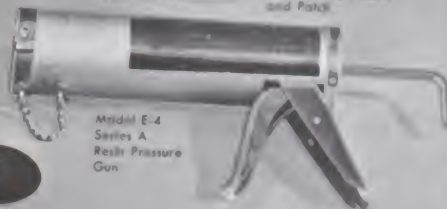
"Scotchcast" Brand Resin No. 4
Left to right: Sizes C, B and A

P-4 Restricting Tape



P-5 Piercing Needle and Patch

"Scotch" Electrical
Semi-Conducting Tape No. 12



Metal E-4
Series A
Resin Pressure
Gun

P-1 Fitting

P-3 Spacer Tape

"Scotch" Electrical
Shielding Tape No. 24



FIGURE 1



FIGURE 2



FIGURE 3



FIGURE 4



FIGURE 5

PROCEDURE FOR TYPICAL RESIN PRESSURE SPLICE

- a. Cable is prepared as usual. Cable preparation should follow the dimensions shown on the appropriate splice drawings on pages 20 through 23. Cable sheath—whether plastic, lead or synthetic—should never be regarded as insulation. Cut back sheath and follow dimensions shown on the drawings. Use compression sleeve connector or solder connection. Remove only enough insulation to conveniently make a good connection. Avoid connectors with sharp corners or irregular shapes and file smooth. Thoroughly clean the outer sheath where resin seals to assure maximum adhesion (Fig. 1).
- b. Wrap each conductor individually with P-3 Screen Spacer Tape as shown in Fig. 2. Stuff all remaining voids, especially in the crotch area, with spacer tape to insure uniform impregnation (Figs. 3 & 4). The spacer tape acts as a frame-work for the splice and allows the user to build a predictable wall of insulation, free of air voids, around each conductor. Wrap the conductors together with a layer of spacer tape after stuffing.
- c. (If the cable is not shielded, the following step may be eliminated.) If the cable is shielded, the shielding must be carried through the splice as shown on the drawings on pages 20 through 22 using "Scotch" Brand No. 24 Copper Braid Tape as an electrostatic shield between the P-3 Spacer Tape build-up and the jumper wire or braided conductor.
- d. The jumper wire is joined and soldered (Fig. 5). Wrap the entire splice with a final serving of spacer tape and extend the tape 3" beyond the end of the sheath on each side of the splice to insure a positive moisture seal. The thickness of this serving should be roughly 3/16 inch (approx. 5mm). This spacer tape may be butt-lapped to avoid badly shaped and hard-to-tape splices.

The taper shown in each illustration is obtained by wrapping in a level manner and reducing the length of each serving until the recommended diameter is reached.

Locate the P-1 in position for convenient with the first serving by a check valve as the gun nozzle is removed.

The tape envelope will be one layer of half-width. The method of leak-free envelope. Starting and continue to the end of the spacer build-up it conforms easily. This may cause resin to the opposite side of

Since the tape envelope is restricted during the P-4 Restricting Tape. Starting at one end, Tape across the splice back to the starting point after the resin has hardened.

Before injecting the material through the end farthest from the injection to escape as the resin

LOADING AND INJECTION

The "Scotchcast" Brand operation. The P-5 "Unusually simplifies the slotted piercing edges of or folds in the bag material.

- e. Locate the P-1 Injection Fitting at one end of the splice in a position for convenient gun handling. The fitting is held down with the first serving of No. 33 (Fig. 6). The injection fitting has a check valve action to retain pressure in the splice when the gun nozzle is removed.



FIGURE 6

The tape envelope which holds the resin inside the spacer "mold" is one layer of half-lapped "Scotch" No. 33, 1½" (38.1mm) wide. The method of applying the tape is important to insure a leak-free envelope. Start the tape on one side of the injection fitting and continue half-lap taping one inch (25mm) beyond the end of the spacer build-up. Pull the tape firmly and stretch it so that it conforms easily. Do not let tape gap or wrinkle since this may cause resin leaks. Start the second strip of No. 33 on the opposite side of the injection fitting and proceed as before.



FIGURE 7

- f. Since the tape envelope stretches under pressure, it must be restricted during the injection of the resin. An outer wrap of P-4 Restricting Tape is wrapped firmly over the plastic envelope. Starting at one end, (Fig. 7) half-lap one serving of Restricting Tape across the splice, then reverse and half-lap a second serving back to the starting point. The Restricting Tape may be removed after the resin has hardened.



FIGURE 8

- g. Before injecting the resin, two or three small holes are punctured through the envelope at the end of the spacer build-up farthest from the injection fitting (Fig. 8). These holes allow air to escape as the resin, under pressure, saturates the spacer tape.

LOADING AND INJECTING INSTRUCTIONS

The "Scotchcast" Brand Model E-4 Pressure Gun is used for this operation. The P-5 "Unipak" Self-piercing Nozzle (Fig. 9), considerably simplifies the loading and injection process. The long, slotted piercing edges prevent blocking the flow of resin by tucks or folds in the bag material.

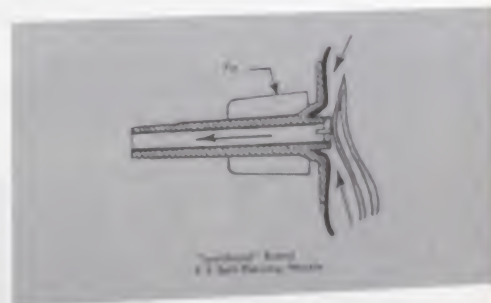


FIGURE 9

- a. Mix the contents of the "Unipak" according to the instructions on the package. Always use "Unipak" size C in preference to sizes B or A when the splice requires over 6 fluid ounces of resin.

- b. Remove paper liner from a tape patch (packed with P-5 "Unipak" Self-piercing Nozzles).
- c. Place hole in tape patch over P-5 Nozzle and center the assembly near the narrow edge of the *mixed* "Unipak". (See Fig. 10.)

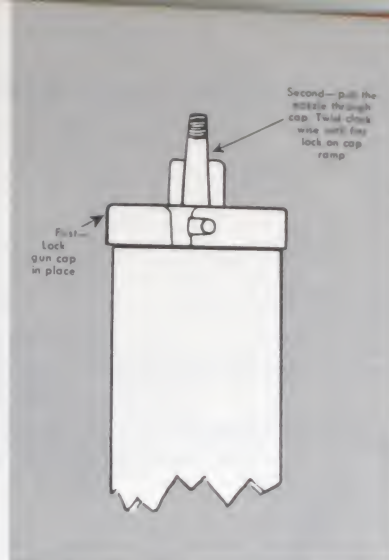
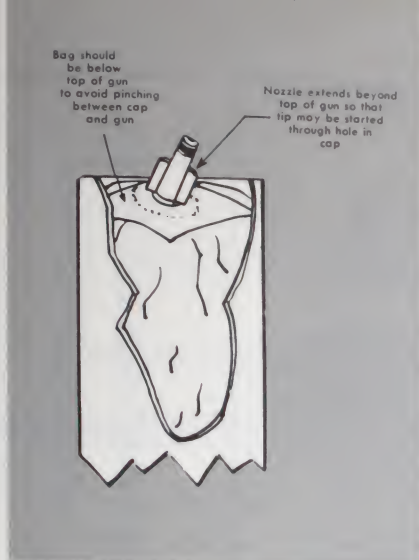


- Grasp the "Unipak" in both hands, holding it roughly cylindrical so it can easily slide into the gun barrel.
- Roll or bunch the end of the "Unipak" opposite the nozzle. This will force some resin toward the nozzle end and improve the cylindrical shape for loading.
- Slide the bag into the gun barrel. Work the handles so the nozzle tip sticks out of the barrel. Tuck in any

- d. Start the tip of the nozzle through the hole in gun cap. Lock gun in place.
- e. Pull nozzle until fins come completely through cap. Twist clockwise to lock nozzle to cap (fins engage cap ramps). Gun is now ready for use. No piercing tool is required.



To unload gun, unlock assembly can then be e
When more than one splice, an assistant can first is being injected
c. Wiping accidental drips is the easiest cleanup soap and water.



3. INJECTING RESIN INTO A SPLICE

- Lightly press the threaded tip of the nozzle into the P-1 Injection Fitting on the splice.
- Rotate entire gun 3 or 4 turns (clockwise) to engage nozzle firmly and form a liquid-tight coupling.
- Work gun handle until resistance is felt. A slight extra pressure on handle will cause the cutting edges of the nozzle to pierce the "Unipak" and permit resin to be pumped into the splice. When small droplets of resin appear at the vent holes, puncture two or three holes at the end nearest the injection fitting. Continue with injection until small droplets appear at these vents.
- To remove gun from splice, retract piston rod handle, rotate entire gun counter-clockwise to unscrew nozzle from fitting.

4. GENERAL HINTS ON INJECTING RESIN

- To unload gun, unlock gun cap and remove. Nozzle and bag assembly can then be easily unlocked from cap and discarded.
- When more than one "Unipak" is needed to fill a single splice, an assistant can prepare the next "Unipak" while the first is being injected.
- Wiping accidental drips or spills while the resin is still liquid is the easiest cleanup method. Wash hands thoroughly with soap and water.



Splice envelope—One layer of 1/2 lapped "Scotch" Brand No. 33, 1/4" wide, 1/2" overlap, 1/2" lapped Scotch Brand P-4 Resin Tape.

"Scotchcast" Brand P-3 spacer—second buildup

One layer of "Scotch" Brand Semi-Conducting Tape No. 13 covering cable semi-conductive material and shield. Strips tape to reduce tape width to 1/2"

"Scotchcast" Brand P-1 injection filling

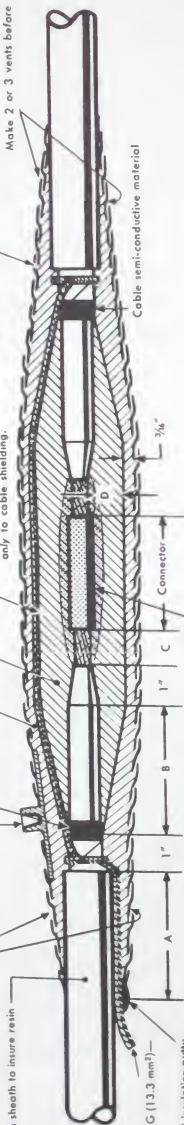
Make 2 or 3 vents after resin appears at far end.

Scrape and clean sheath to insure resin adhesion

"Scotchcast" Brand P-3 Spacer Tape. Buildup. Wrap to within 1/4" of Semi-Conducting Tape No. 13.

One layer "Scotch" Brand Shielding Tape No. 24, with 1/2" overlap, is applied over "Scotchcast" Brand P-3 spacer tape. Solder only to cable shielding.

Make 2 or 3 vents before injecting resin.



One layer of "Scotch" Brand Semi-Conducting Tape No. 13 covering cable semi-conductive material and shield. Strips tape to reduce tape width to 1/2"

FOR SHIELDED CABLES RATED* 5000-VOLTS PHASE TO GROUND AND LOWER

CABLE SIZE	APPROX. CABLE O.D. INCHES	DIMENSIONS (INCHES)				MATERIALS REQUIRED FOR EACH SPICE									
		A	B	C	D	"UNIPAKS"		P-3 SPACER -ROLLS-	P-4 RESTRICTING TAPE -ROLLS-	P-5 INJECT. POK NOZZLES	P-1 INJECT. FITTINGS	No. 24 TAPE FEET	No. 13 TAPE FEET	No. 33 TAPE FEET	No. 13 TAPE FEET
						"B"	"C"								
14 AWG	.80	3	3 1/2	1/2	7/8	1	1	1 1/2	1 1/2	1	1	1 1/2	1 1/2	1 1/2	1 1/2
16 AWG	.85	3	3 1/2	1/2	7/8	1	1	1 1/2	1 1/2	1	1	1 1/2	1 1/2	1 1/2	1 1/2
18 AWG	.92	3	3 1/2	1/2	7/8	1	1	1 1/2	1 1/2	1	1	1 1/2	1 1/2	1 1/2	1 1/2
20 AWG	.96	3	3 1/2	1/2	7/8	1	1	1 1/2	1 1/2	1	1	1 1/2	1 1/2	1 1/2	1 1/2
22 AWG	1.01	3	3 1/2	1/2	7/8	1	1	1 1/2	1 1/2	1	1	1 1/2	1 1/2	1 1/2	1 1/2
24 AWG	1.06	3 1/2	3 1/2	1/2	7/8	1	1	1 1/2	1 1/2	1	1	1 1/2	1 1/2	1 1/2	1 1/2
26 AWG	1.11	3 1/2	3 1/2	1/2	7/8	1	1	1 1/2	1 1/2	1	1	1 1/2	1 1/2	1 1/2	1 1/2
28 AWG	1.19	3 1/2	3 1/2	1/2	7/8	1	1	1 1/2	1 1/2	1	1	1 1/2	1 1/2	1 1/2	1 1/2
30 AWG	1.28	3 1/2	3 1/2	1/2	7/8	1	1	1 1/2	1 1/2	1	1	1 1/2	1 1/2	1 1/2	1 1/2
32 AWG	1.33	3 1/2	3 1/2	1/2	7/8	1	1	1 1/2	1 1/2	1	1	1 1/2	1 1/2	1 1/2	1 1/2
34 AWG	1.38	3 1/2	3 1/2	1/2	7/8	1	1	1 1/2	1 1/2	1	1	1 1/2	1 1/2	1 1/2	1 1/2
36 AWG	1.46	3 1/2	3 1/2	1/2	7/8	1	1	1 1/2	1 1/2	1	1	1 1/2	1 1/2	1 1/2	1 1/2

*8.7 KV PHASE TO PHASE

FOR SHIELDED CABLES RATED* 7500-VOLTS PHASE TO GROUND

CABLE SIZE	APPROX. CABLE O.D. INCHES	DIMENSIONS (INCHES)				MATERIALS REQUIRED FOR EACH SPICE									
		A	B	C	D	"UNIPAKS"		P-3 SPACER -ROLLS-	P-4 RESTRICTING TAPE -ROLLS-	P-5 INJECT. POK NOZZLES	P-1 INJECT. FITTINGS	No. 24 TAPE FEET	No. 13 TAPE FEET	No. 33 TAPE FEET	No. 13 TAPE FEET
						"B"	"C"								
14 AWG	.90	3	5	1/2	3/4	1	1	3	2 1/2	2	1	1 1/2	1 1/2	1 1/2	1 1/2
16 AWG	.96	3	5	1/2	3/4	1	1	3	2 1/2	2	1	1 1/2	1 1/2	1 1/2	1 1/2
18 AWG	1.00	3	5	1/2	3/4	1	1	3	2 1/2	2	1	1 1/2	1 1/2	1 1/2	1 1/2
20 AWG	1.04	3	5	1/2	3/4	1	1	3	2 1/2	2	1	1 1/2	1 1/2	1 1/2	1 1/2
22 AWG	1.08	3 1/2	5	1/2	3/4	1	1	3 1/2	2 1/2	2	1	1 1/2	1 1/2	1 1/2	1 1/2
24 AWG	1.13	3 1/2	5	1/2	3/4	1	1	3 1/2	2 1/2	2	1	1 1/2	1 1/2	1 1/2	1 1/2
26 AWG	1.19	3 1/2	5	1/2	3/4	1	1	3 1/2	2 1/2	2	1	1 1/2	1 1/2	1 1/2	1 1/2
28 AWG	1.27	3 1/2	5	1/2	3/4	1	1	3 1/2	2 1/2	2	1	1 1/2	1 1/2	1 1/2	1 1/2
30 AWG	1.32	3 1/2	5	1/2	3/4	1	1	3 1/2	2 1/2	2	1	1 1/2	1 1/2	1 1/2	1 1/2
32 AWG	1.38	3 1/2	5	1/2	3/4	1	1	3 1/2	2 1/2	2	1	1 1/2	1 1/2	1 1/2	1 1/2
34 AWG	1.42	3 1/2	5	1/2	3/4	1	1	3 1/2	2 1/2	2	1	1 1/2	1 1/2	1 1/2	1 1/2
36 AWG	1.51	3 1/2	5	1/2	3/4	1	1	3 1/2	2 1/2	2	1	1 1/2	1 1/2	1 1/2	1 1/2

*13 KV PHASE TO PHASE

"SCOTCHCAST" BRAND RESIN PRESSURE INLINE SPICE — SHIELDED CABLE *7 1/2 KV PHASE TO GROUND AND LOWER

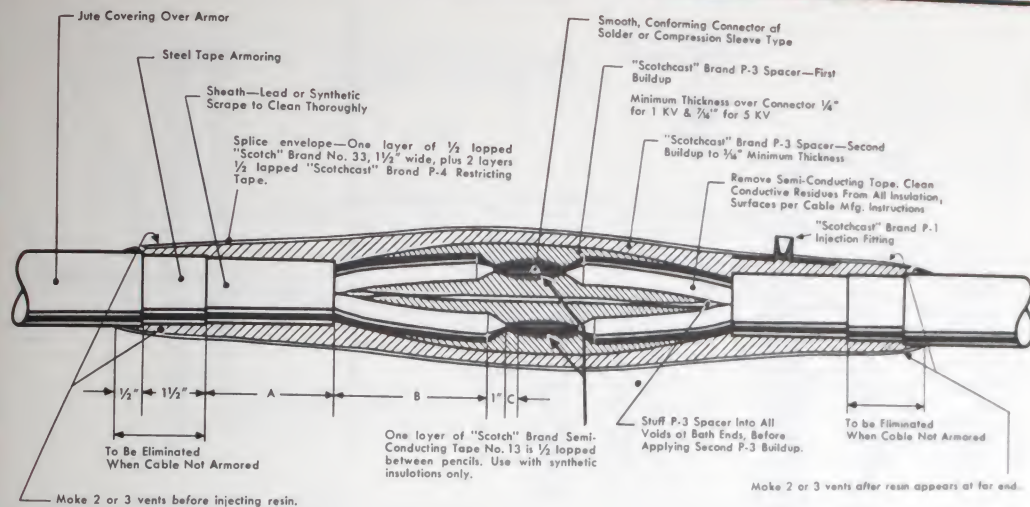
Cable Size	Approx. O.D. Over Sheath-In.	Oil Paper	Other
14 AWG	8.63	1.11	1.26
16 AWG	8.133	1.21	1.40
18 AWG	7.637	1.29	1.54
20 AWG	7.141	1.39	1.68
22 AWG	6.645	1.45	1.74
24 AWG	6.149	1.54	1.83
26 AWG	5.653	1.55	1.93
28 AWG	5.157	1.57	2.04
30 AWG	4.661	1.59	2.17
32 AWG	4.165	1.69	2.37
34 AWG	3.669	1.77	2.49
36 AWG	3.173	1.85	2.70
38 AWG	2.677	1.91	2.88

*17 KV PHASE TO PHASE

Cable Size	Approx. O.D. Over Sheath-In.	Oil Paper	Other
14 AWG	8.63	.84	.96
16 AWG	8.133	.96	1.07
18 AWG	7.637	1.07	1.20
20 AWG	7.141	1.19	1.38
22 AWG	6.645	1.29	1.54
24 AWG	6.149	1.44	1.68
26 AWG	5.653	1.53	1.83
28 AWG	5.157	1.63	1.99
30 AWG	4.661	1.72	2.17
32 AWG	4.165	1.80	2.37
34 AWG	3.669	1.84	2.59
36 AWG	3.173	1.94	2.88

*17 KV PHASE TO PHASE

"SCOTCH"



3-CONDUCTOR, 5 KV*, NON-SHIELDED

Cable Size		Approx. O.D. Over Sheath-In.		Dimensions—Inches			Materials Required Per Splice									
AWG	MCM	mm ²	Oil Paper	Other	A	B	C	"Unipak"s "B"	"C"	P-3 Spacer Rolls	No. 33 Tape Feet	P-4 Restr. Rolls	P-5 "Unipak" Nozzles	P-1 Inject. Fitting	No. 13 Tape Feet	
8	8.3	1.11	1.26	3	3 1/4	3	1/4	1	2.5	12	1	1	1	1	2	
6	13.3	1.21	1.40	3	3 1/4	3	1/4	1	3.0	13	1	1	1	1	2	
4	21.2	1.29	1.50	3	3 1/2	3 1/2	1/2	1	1	3.0	14	1	2	1	2	
2	33.6	1.39	1.63	3	3 3/4	3 3/4	1/2	1	2	3.5	15	1	2	1	2	
1	42.4	1.45	1.74	3	4	3 3/4	3/4	2	4	16	1	2	1	2 1/2	1	
1/0	53.5	1.54	1.83	3	4 1/4	3 3/4	3/4	2	4	17	1	2	1	2	1	
2/0	67.8	1.55	1.93	3	4 1/2	3 3/4	3/4	1	2	4.5	18	1.5	3	1	3	
3/0	85.0	1.57	2.04	3 1/4	4 1/2	3 3/4	3/4	1	2	5	19	1.5	3	1	3	
4/0	107.2	1.59	2.17	3 1/4	4 1/2	3 3/4	3/4	1	3	6	21	1.5	3	1	3	
250	126.7	1.60	2.37	3 1/4	4 3/4	3 3/4	1	6	3	6.5	22	1.5	4	1	3 1/2	
300	152.0	1.69	2.49	3 1/4	5	3 3/4	1	1	3	7	23	2	4	1	3 1/2	
350	177.3	1.77	2.59	3 1/4	5	3 1/2	1	1	4	8	25	2.5	4	1	3 1/2	
400	202.7	1.85	2.70	3 1/2	5	3 1/2	1	1	4	8.5	27	2.5	5	1	3 1/2	
500	253.4	2.01	2.88	3 3/4	5	3 1/2	1	1	5	9	29	2.5	5	1	4	

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by good workmen, plus a safety factor. Splices should be constructed to shape and dimensions shown.

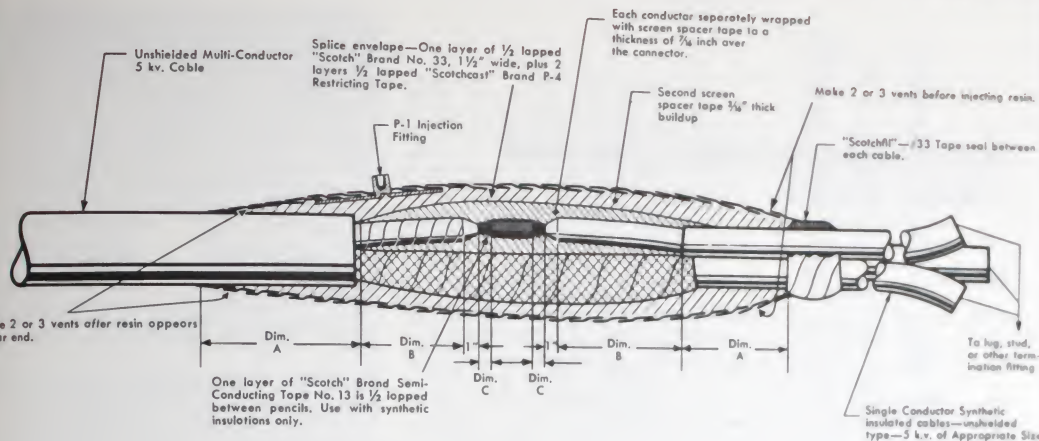
NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by good workmen, plus a safety factor. Splices should be constructed to shape and dimensions shown. Dimensions shown for 3-Conductor (A, B and C) are to be used for 4-Conductor.

* 8.7 KV PHASE TO PHASE

3-Conductor, 1 KV*, Phase to Ground Oil-Paper Insulated Cable															4-Conductor 1 KV, Phase to Ground Oil-Paper Insul.						
Cable Size		Approx. OD Over Sheath-In. Oil Paper	Dimensions—Inches			"Unipak"s		Materials Required Per Splice						Materials Required Per Splice							
AWG	MCM		A	B	C	"B"	"C"	P-3 Spacer Rolls	No. 33 Tape Feet	P-4 Restr. Rolls	P-5 "Unipak" Nozzles	P-1 Inject. Fitting	"Unipak"s "B"	"C"	P-3 Spacer Rolls	No. 33 Tape Feet	P-4 Restr. Rolls	P-5 "Unipak" Nozzles	P-1 Inject. Fittings		
8	8.3	.84	3	3 1/4	1/4	1	1.5	10	1	1	1	1	1	1	2	14	1	1	1	1	
6	13.3	.96	3	3 1/4	1/4	1	2	11	1	1	1	1	1	1	3	15	1	2	1	1	
4	21.2	1.07	3	3 1/2	1/2	1	2	12	1	1	1	1	1	1	3	17	1	2	1	1	
2	33.5	1.20	3	3 3/4	1/2	1	2	13	1	1	1	1	1	2	3.5	19	1.5	2	1	1	
1	42.4	1.29	3	4	3/4	1	1	2.5	14	1	2	1	1	2	3.5	20	1.5	2	1	1	
1/0	63.5	1.38	3	4 1/4	3/4	1	1	2.5	15	1	2	1	1	2	4	22	2	2	1	1	
2/0	67.8	1.41	3	4 1/2	3/4	1	1	3	16	1	2	1	1	2	4	23	2	2	1	1	
3/0	85.0	1.44	3	4 1/2	3/4	1	1	3	17	1.5	2	1	1	2	5	25	2.5	3	1	1	
4/0	107.2	1.46	3	4 1/2	3/4	1	2	3.5	19	1.5	2	1	1	2	5.5	27	2.5	3	1	1	
250	126.7	1.53	3 1/4	4 1/4	1	2	4	20	1.5	2	1	1	1	2	5.5	28	2.5	3	1	1	
300	152.0	1.63	3 1/4	5	1	2	4	21	1.5	2	3	1	1	3	6.0	31	3	4	1	1	
350	177.3	1.72	3 1/4	5	1	1	2	4	23	2.0	3	1	1	3	7.0	34	3	4	1	1	
400	202.7	1.80	3 1/2	5	1	1	2	5	25	2.0	3	1	1	4	7.5	36	3	4	1	1	
500	253.4	1.94	3 1/2	5	1	3	5.5	27	2.5	3	1	1	1	4	7.5	36	3	4	1	1	

* 1.7 KV PHASE TO PHASE

"SCOTCHCAST" BRAND RESIN PRESSURE INLINE SPLICE MULTI-CONDUCTOR
1 KV & 5 KV, PHASE TO GROUND, NON-SHIELDED



3-CONDUCTOR, 5 KV*, NON-SHIELDED

Cable Size		Approx. O.D. Over Sheath-In.		Dimensions—Inches			Materials Required Per Splice							
				A	B	C	"Unipak"s "B" "C"		P-3 Spacer Rolls	No. 22 Tape Feet	P-4 Restr. Rolls	P-5 "Unipak"s Nozzles	P-1 Inject. Fitting	No. 13 Tape Feet
AWG	MCM	mm ²	Oil Paper	Other	Oil Paper	Other	"B"	"C"						
8	8.3	1.11	1.26	3	3 1/4	3 1/4	1	2.5	12	1	1	1	1	2
6	13.3	1.21	1.40	3	3 1/4	3 1/4	1	3.0	13	1	1	1	1	2
4	21.2	1.29	1.50	3	3 1/2	3 1/2	1	3.0	14	1	2	1	1	2
2	33.6	1.39	1.63	3	3 3/4	3 3/4	2	3.5	15	1	2	1	2	2
1	42.4	1.45	1.74	3	4	3 3/4	2	4	16	1	2	1	2 1/2	2 1/2
1/0	53.5	1.54	1.83	3	4 1/4	3 3/4	2	4	17	1	2	1	3	3
2/0	67.8	1.55	1.93	3	4 1/2	3 3/4	1	2	4.5	18	1.5	3	1	3
3/0	85.0	1.57	2.04	3 1/4	4 1/2	3 3/4	1	2	5	19	1.5	3	1	3
4/0	107.2	1.59	2.17	3 1/4	4 1/2	3 3/4	3	6	21	1.5	3	1	3	3
250	126.7	1.60	2.37	3 1/4	4 3/4	3 1/4	1	6	3	6.5	22	1.5	4	3 1/2
300	152.0	1.69	2.49	3 1/4	5	3 1/4	1	1	3	7	23	2	4	1
350	177.3	1.77	2.59	3 1/4	5	3 1/2	1	4	8	25	2.5	4	1	3 1/2
400	202.7	1.85	2.70	3 1/2	5	3 1/2	1	4	8.5	27	2.5	5	1	3 1/2
500	253.4	2.01	2.88	3 3/4	5	3 1/2	1	5	9	29	2.5	5	1	4

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by good workmen, plus a safety factor. Splices should be constructed to shape and dimensions shown.

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by good workmen, plus a safety factor. Splices should be constructed to shape and dimensions shown. Dimensions shown for 3-Conductor (A, B and C) are to be used for 4-Conductor.

* 8.7 KV PHASE TO PHASE

3-Conductor, 1 KV*, Phase to Ground Oil-Paper Insulated Cable													4-Conductor 1 KV, Phase to Ground Oil-Paper Insul.									
Cable Size		Approx. OD Over Sheath-In.	Dimensions—Inches			"Unipak"s "B" "C"		Materials Required Per Splice					Materials Required Per Splice									
			A	B	C			P-3 Spacer Rolls	No. 22 Tape Feet	P-4 Restr. Rolls	P-5 "Unipak"s Nozzles	P-1 Inject. Fitting	"Unipak"s "B" "C"	P-3 Spacer Rolls	No. 22 Tape Feet	P-4 Restr. Rolls	P-5 "Unipak"s Nozzles	P-1 Inject. Fittings				
AWG MCM	mm²	Oil Paper	A	B	C	"B"	"C"															
8	8.3	.84	3	3 1/4	1/4	1	1.5	10	1	1	1	1	1	1	1	2	14	1	1	2	1	1
6	13.3	.96	3	3 1/4	1/4	1	2	11	1	1	1	1	1	1	1	3	16	1	1	2	1	1
4	21.2	1.07	3	3 1/2	1/2	1	2	12	1	1	1	1	1	1	1	3	17	1	1	2	1	1
2	33.5	1.20	3	3 3/4	1/2	1	2	13	1	1	1	1	1	1	1	2	3.5	19	1.5	2	1	1
1	42.4	1.29	3	4	3/4	1	1	2.5	14	1	2	1	2	1	2	3.5	20	1.5	2	2	1	1
1/0	53.5	1.38	3	4 1/4	3/4	1	1	2.5	15	1	2	1	2	1	2	4	22	2	2	2	1	1
2/0	67.8	1.41	3	4 1/2	3/4	1	1	3	16	1	2	1	2	1	2	4	23	2	2	3	1	1
3/0	85.0	1.44	3	4 1/2	3/4	1	1	3	17	1.5	2	1	2	1	2	5	25	2.5	3	1	1	1
4/0	107.2	1.46	3	4 1/2	3/4	1	2	3.5	19	1.5	2	1	1	2	3.5	27	2.5	3	1	1	1	1
250	126.7	1.53	3 1/4	4 1/4	1	2	4	20	1.5	2	1	1	2	3.5	28	2.5	3	1	1	1	1	1
300	152.0	1.63	3 1/4	5	1	2	4	21	1.5	2	1	1	2	3	6.0	31	3	3	1	1	1	1
350	177.3	1.72	3 1/4	5	1	1	2	4	23	2.0	3	1	3	1	7.0	34	3	4	1	1	1	1
400	202.7	1.80	3 1/2	5	1	1	2	5	25	2.0	3	1	3	1	7.5	36	3	4	1	1	1	1
500	253.4	1.94	3 1/2	5	1	3	5.5	27	2.5	3	1	4	1	4	7.5	36	3	4	1	1	1	1

* 1.7 KV PHASE TO PHASE

TRANSITION SPLICE OR TERMINATION OF MULTI-CONDUCTOR CABLE OF 5 KV AND LOWER RATING

STEP 1

Wrap each conductor separately as the inline joints. Stuff the crotches and voids with P-3 Spacer Tape. Up to this point the "T" Splice is treated in much the same manner as inline joints except for the care taken in training the individual cores into position.

STEP 2

After the final serving of P-3 Spacer Tape is applied over the entire splice, a special method should be used in applying "Scotch" Brand Electrical Tape No. 33 as the plastic tape envelope. Reinforce the area shown in Figure 1 with two strips of "Scotch" No. 33. This will be a point of considerable pressure during the resin injection.

STEP 3

Start taping the main feeder with one serving of "Scotch" No. 33 half-lapped as shown in figure 2. Then tape branch cable after placing injection fitting (figure 3). Finally, apply P-4 Restricting Tape over-all, with two servings half lapped.

STEP 4

Pierce 2 or 3 vent holes on both ends of the splice on the main cable (figure 4). As soon as resin appears at these locations, pierce vent holes on branch and continue injection of resin until it appears at vents.



Figure 1

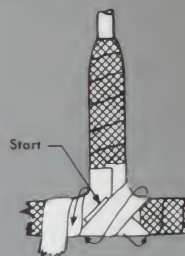


Figure 2

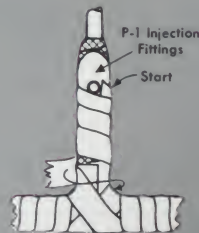


Figure 3

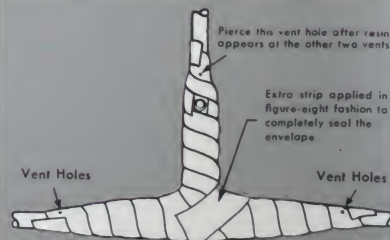
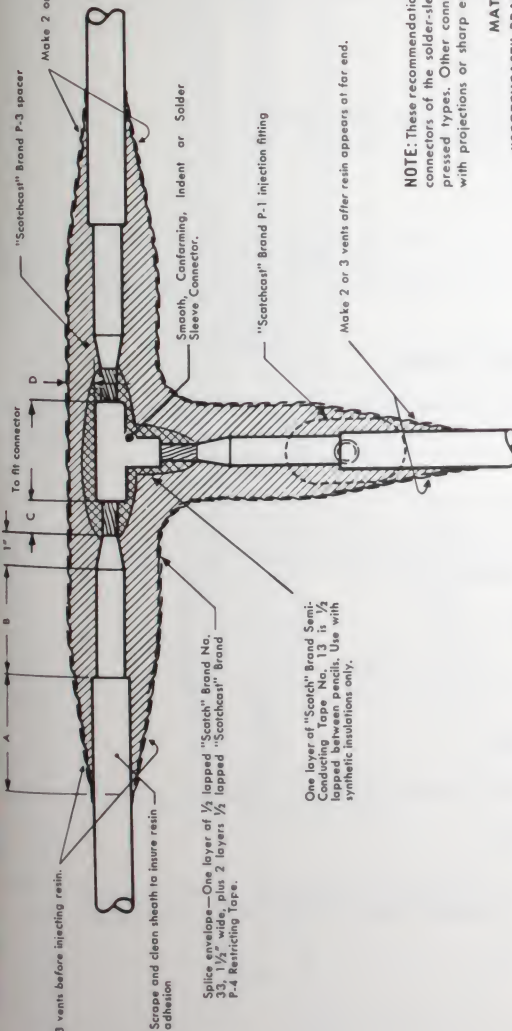


Figure 4

Make 2 or 3 vents before injecting resin.



Splice envelope—One layer of $\frac{1}{2}$ lapped "Scotch" Brand No. 33, $1\frac{1}{2}$ " wide, plus 2 layers $\frac{1}{2}$ lapped "Scotchcast" Brand P-4 Restricting Tape.

One layer of "Scotch" Brand Semi-Conducting Tape No. 33 $\frac{1}{2}$ " wide, lapped between pencils. Use with synthetic insulations only.

Make 2 or 3 vents after resin appears at far end.

NOTE: These recommendations are based on smooth, conforming connectors of the solder-sleeve, or smooth mechanically compressed types. Other connectors having irregular shapes, or with projections or sharp edges should be avoided.

MATERIALS LIST

"SCOTCHCAST" BRAND RESIN PRESSURE SPLICE

This Materials List is provided to assist the user in determining the amounts of material required for splicing various sizes of cable. A reasonable safety factor has been included to allow for variations in technique by different craftsmen, and for differences in size and construction of cable by various manufacturers. The user is referred to the Design and Engineering Manual for the "SCOTCHCAST" Brand Resin Pressure Splice for detailed instructions for applying the various materials.

FOR UNSHIELDED CABLES RATED* 5000-VOLTS PHASE TO GROUND AND LOWER

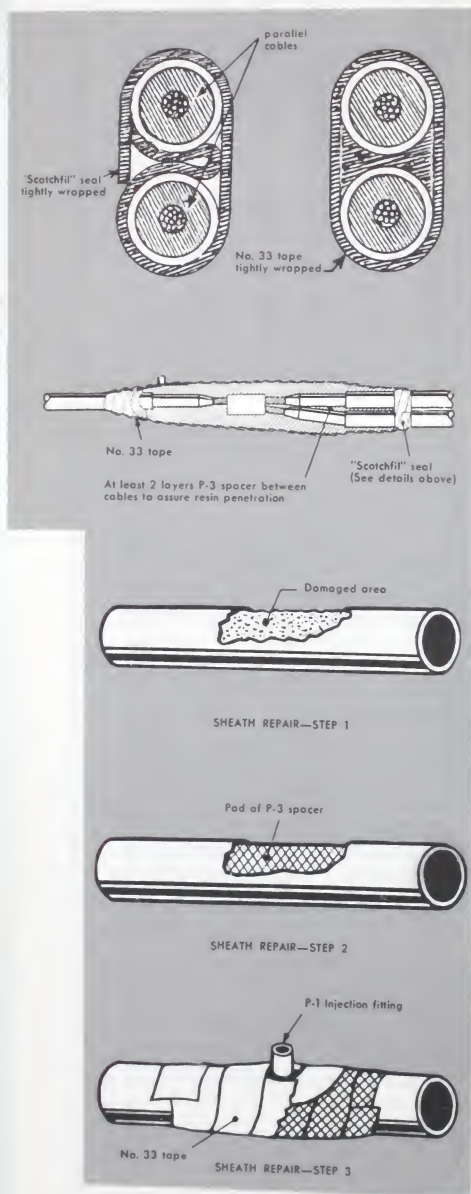
Cable Size	Approx. Cable O.D. Inches	DIMENSIONS (INCHES)				MATERIALS REQUIRED FOR EACH SPLICE							
						"UNIPAKS"		P-3 Spacer -Rolls-	P-4 Restrict- ing Tape -Rolls-	P-5 Uni- pak Nozzles	P-1 Injec- tion Fittings	No. 13 Tape Fl.	
		A	B	C	D	"B"	"C"						
#4 AWG	.65	3	3 1/8	1/2	3/8	1	1	1	8	1/2	1	1	1.5
#2 "	.72	3	3 1/8	1/2	3/8	1	1	1	8	1/2	1	1	1.5
#1 "	.75	3	3 1/8	3/4	3/8	1	1	1	8	1/2	1	1	1.5
1/0 "	.79	3	3 1/8	3/4	3/8	1	1	1	8	1	1	1	1.5
2/0 "	.84	3	3 1/8	3/4	3/8	1	1	1	8	1	1	1	2
3/0 "	.89	3 1/8	3 1/8	3/4	3/8	1	1 1/2	1	10	1	1	1	2
4/0 "	.98	3 1/8	3 1/8	3/4	3/8	1	1 1/2	1	10	1	1	1	2
250 MCM	1.06	3 1/8	3 1/8	1	3/8	1	2	1	10	1	1	1	2.5
300 "	1.11	3 1/8	3 1/8	1	3/8	1	2	1	12	1	1	1	2.5
350 "	1.16	3 1/8	3 1/8	1	3/8	1	1	1	12	1	2	1	3
400 "	1.21	3 1/8	3 1/8	1	3/8	1	1	1	15	1	2	1	3
500 "	1.30	3 1/8	3 1/8	1	3/8	1	1	1	15	1 1/2	1	1	3

*8.7 KV PHASE TO GROUND

"SCOTCHCAST" BRAND RESIN PRESSURE INLINE SPLICE — UNSHIELDED CABLE *5 KV PHASE TO GROUND AND LOWER

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PROCEDURE FOR "SCOTCHCAST" BRAND RESIN PRESSURE WYE SPLICE

The parallel wye splice is easier to construct than a T-Splice. First consideration should be given to this type of joint in tap splicing. This construction is only used on *non-shielded cable*.

In the parallel wye, the tap and run cables come out of the splice side by side. The crotch between them is sealed against resin as follows:

STEP 1

Wrap a pad of $\frac{1}{2}$ " wide "Scotchfil" Brand Electrical Insulating Putty between and around the cables.

STEP 2

Tightly overwrap the "Scotchfil" with "Scotch" Brand Electrical Tape No. 33 (figure 1). The parallel cables can then be treated as a single cable in the subsequent operations.

SHEATH REPAIR

The resin pressure technique is useful in repairing damaged cable sheath. If the damaged sheath has a section torn out (figure 3) it can be repaired in the following manner:

STEP 1

Thoroughly clean the sheath around the damaged area to insure resin adhesion (figure 3).

STEP 2

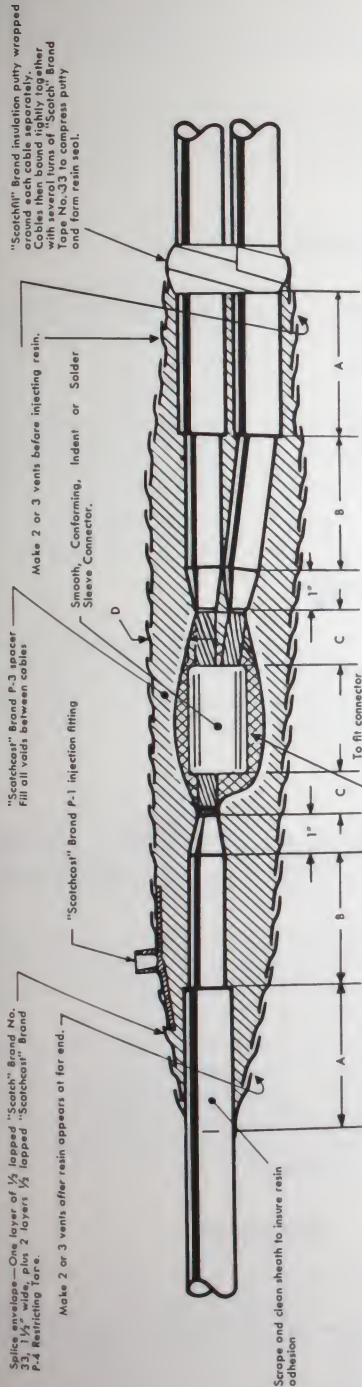
Form a pad of P-3 Spacer Tape to neatly fit in the damaged area (figure 4).

STEP 3

Wrap several layers of P-3 Spacer Tape around the cable (figure 5).

STEP 4

Locate the injection fitting, apply the plastic tape envelope and P-4 Restricting Tape (figure 5). Pierce vent holes and inject resin.



One layer of "Scotch" Brand Semi-Conducting Tape No. 13 is one half inch wide and overlaps the splice with 1/2 inch overlap.

NOTE: These recommendations are based on smooth, conforming connectors of the solder-leave, or smooth mechanically compressed types. Other connectors having irregular shapes, or with projections or sharp edges should be avoided.

FOR UNSHIELDED CABLES RATED* 5000-VOLTS PHASE TO GROUND AND LOWER

Cable Sizes	Approx. Cable O.D. Inches	DIMENSIONS (INCHES)						MATERIALS REQUIRED FOR EACH SPICE					
		UNIPAKS"			P-3			P-4			P-5		
		A	B	C	D	"B"	"C"	Spacer -Rolls-	Tape No. 22 ing Tape -Rolls-	Restric-Tape	Un-Unit-	Injec-tion	No. 13 Tape Ft.
#4 AWG	.65	3	3 1/4	1/2	3/4		1	1 1/2	12	1	1	1	1.5
#2 "	.72	3	3 1/4	1/2	3/4		1	1 1/2	12	1	1	1	1.5
#1 "	.75	3	3 1/4	3/4	3/4		1	1 1/2	12	1	1	1	1.5
1/0 "	.79	3	3 1/4	3/4	3/4		1	1 1/2	12	1 1/2	2	1	1.5
2/0 "	.84	3	3 1/4	3/4	3/4		1	2	12	1 1/2	2	1	2
3/0 "	.89	3 1/4	3 1/4	3/4	3/4		1	2 1/2	15	1 1/2	2	1	2
4/0 "	.98	3 1/4	3 1/4	3/4	3/4		1	2 1/2	15	1 1/2	2	1	2
250 MCM	1.06	3 1/4	3 1/4	1	3/4		2	3	15	1 1/2	2	1	2.5
300 "	1.11	3 1/4	3 1/4	1	3/4		2	3	18	2	2	1	2.5
350 "	1.16	3 1/4	3 1/4	1	3/4		1	2	3 1/2	2	3	1	3
400 "	1.21	3 1/4	3 1/4	1	3/4		1	2	4	2.5	3	1	3
500 "	1.30	3 1/4	3 1/4	1	3/4		1	2	4	2.5	3	1	3

*8.7 KV PHASE TO PHASE

MATERIALS LIST

"SCOTCHCAST" BRAND RESIN PRESSURE SPICE

This Materials List is provided to assist the user in determining the amounts of material required for splicing various sizes of cable. A reasonable safety factor has been included to allow for variations in technique by different craftsmen, and for differences in size and construction of cable by various manufacturing plants. The user is referred to the Design and Engineering Manual for the "SCOTCHCAST" Brand Resin Pressure Splice for detailed instructions for applying the various materials.

"SCOTCHCAST" BRAND RESIN PRESSURE PARALLEL WYE SPICE — UNSHIELDED CABLE *5 KV PHASE TO GROUND AND LOWER



Scotchrap[®] PIPE PROTECTION TAPES NO. 50 AND NO. 51 BRAND

Designed specifically to protect pipe, conduit and lead covered cable from corrosion.

"Scotchrap" is tough, has a high degree of insulation resistance and resists the action of acids, alkalies, fungi, and bacteria. One other feature—high conformance—makes "Scotchrap" the perfect anti-corrosion tape.

AVERAGE PROPERTIES

	Color	Over-All Thickness	Tensile Str. Lbs./In. Width	Elongation at Break	Adhesion Oz./In. Width
50	Black	.010"	25	225%	35
51	Black	.020"	50	350%	35
	Electric Strength	Insulation Resistance Meg-Ohms	Corrosion Factor	Adhesion (Shear) 80 Min. 1KG/1/2" Sq.	Conductance Micro Micro-Mhos
50	9500 v.	> 1 x 10 ⁴	1.0	80 Min. 1KG/1/2" Sq.	< 1.0
51	18000 v.	> 1 x 10 ⁴	1.0	80 Min. 1KG/1/2" Sq.	< 1.0

TYPICAL APPLICATIONS

- "Scotchrap" No. 50 provides corrosion protection and insulation on lead covered cable, above and below ground.
- Tough "Scotchrap" No. 51 gives abrasion protection on cable being pulled through conduit.

Scotchrap[®] NO. 40 ... FOR COLD WEATHER APPLICATIONS BRAND

"Scotchrap" Brand Pipe Protection Tape No. 40 is a special cold weather formulation designed specifically to be conformable over a broad temperature range. The green PVC tape can be easily applied at temperatures as low as -5° F.

Like No. 50 and 51 it has excellent insulation resistance and electric strength. No. 40 is also designed to be funginert. A balanced high-tack adhesive system is used. Its internal strength stops tape displacement caused by movement of soil or pipe. It too resists the action of acids, alkalies, salts petroleum oils, and refined products such as gasoline and naphtha.

PROPERTIES

Color	Thickness	Elongation at Break	Tensile Strength Lbs./In. of Width	Adhesion Oz./In. of Width	Electric Strength	Insulation Resistance Meg-Ohms
Green	.010"	225%	25	25	10,000 volts	> 1 x 10 ⁴

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 J. M. Williams · 1998, 15, 471

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Microbials (CM) Phylogeny: unc.
Genus: Brevib.
Species: Brevib.
Genus: Brevib.
Species: Brevib.

Minnesota Mining & Manufacturing Co.
181 E. 1st St.
215 Canada Square, Step 70
Salt Lake, Puerto Rico

Microanalysis: Molecular Weight, Carboxylic
 Groups, Amino Groups, etc.
 Lysine Determination: Protein
 Hydrolysis
 P. O. Box 110429

Minerals Mining & Mfg. Co. (Central Africa) Pty Ltd
Sanyang Street 17 &
18, Johannesburg

Instituto de Física de São Carlos
 Universidade de São Carlos
 Caixa Postal 1356
 São Carlos, SP, 13560-970, Brazil
 e-mail: marcelo@fz.fis.ucsb.br

Marine Corps Whiting & Manufacturing AB
Marshallsgatan 6
S-141 85, Nacka, Sweden

Minerals Mining Products, Inc.
Minerals Mining, Inc.
P.O. Box 1157
P.O. Box 4, New Bedford

Integradores Químicos, S.A. (IQC-A)
P.O. Box 2083
Caracas, Venezuela

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International Division **3M**
CORPORATION

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DESIGN AND ENGINEERING MANUAL

FOR SPLICING AND TERMINATING POWER CABLE

WITH

Scotchcast
BRAND

ELECTRICAL INSULATING RESIN

SPLICING? THINK 3M!



SPLICING? THINK 3M!



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PART

1

CABLE PREPARATION



PART I CABLE PREPARA- TION

The splicer must adhere to the following instructions in order to construct good electrical splices.

Because some sheath materials are quite conductive, cable sheath should never be considered as insulation. All cable sheaths should be considered as not clean even if they appear that way. A knife held approximately perpendicular to the cable and pulled as a scraper is one of the best cleaning methods. This method removes wax, dirt, or conductive residues from the cable sheath. Failure to clean the sheath results in a weak resin bond and a possible water path. Clean the sheath at points of resin contact in the splice area. Care must be exercised so that the primary insulation is not cut.

After the sheath has been removed to the appropriate dimension, thoroughly clean any bedding tape or semi-conducting tape from the interface of the primary insulation. After removing this semi-conducting tape, scrape with a knife to remove all remaining traces.

Pencil back the insulation in the connector area. Penciling back of the insulation allows a gradual stress distribution between the interface of different insulation materials.

Preparation of shielded cables is discussed under "Special Techniques", Part V.

PART

2

**PROCEDURE FOR
SELECTING AND CONSTRUCTING
"SCOTCHCAST" BRAND KITS**

PART 2 PROCEDURE FOR SELECTING AND CON- STRUCTING Scotchcast® POURED KITS

- 1) When should a "SCOTCHCAST" poured kit be used? "SCOTCHCAST" poured kits are designed for constructing inline and wye splices but there are certain restrictions that limit the application of these kits. These limitations are due to the many different cables and varied applications. Before a "SCOTCHCAST" Resin kit is used, one should ask the following questions:

- Is there a mold to fit the size and shape?
- Is the cable unshielded?
- Is the voltage 5kv (5000V) or less?
- Can the splice be poured in a horizontal position?

If the answer to any of these questions is "no" then the resin splice should be made with the "SCOTCHCAST" Resin Pressure Method (see Part III).

- 2) What size kits are available? "SCOTCHCAST" poured kits are available for splicing cable diameters from 1/4" to 1-7/16". Inline splicing kits are designated by the 82-A series, such as 82-A, 82-A1, 82-A2 and 82-A3. Wye splices are designated by the letter B, such as 82-B1 (for 5000 volt insulations) and 90-B1 for cathodic protection.

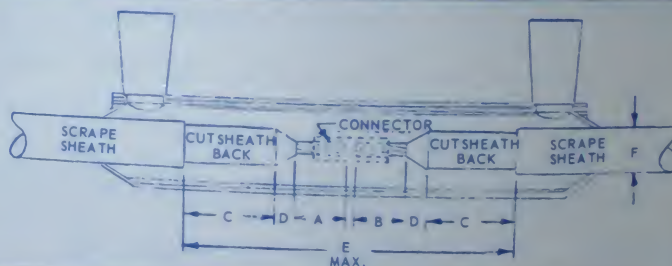
- 3) Cable preparation.

Prepare the cable by the method discussed in Part I to the dimensions as shown below for that particular kit.

Scotchcast®
BRAND

Splicing Kits

**82A, 82-A1, 82-A2,
82-A3**



"SCOTCHCAST" KIT NO.	CABLE O.D. (F) RANGE	BARED CONDUCTOR LENGTH (A)	BARED CONDUCTOR LENGTH (B)	PENCILLED LENGTH (D)	MAXIMUM CONNECTION LENGTH OR (A+B) MAX.	MAXIMUM SHEATH OPENING (E)	SHEATH CUTBACK (C)
82A	1/4" to 3/4"	7/8" with "S/L", other to fit connector	5/8" with "S/L", others to fit connector	1/2"	1-1/2"	4"	3/4"
82A1	1/4" to 5/8"	7/8" with "S/L", others to fit connector	5/8" with "S/L", others to fit connector	1/2"	1-1/2"	4"	3/4"
82A2	5/8" to 1"	to fit connector	to fit connector	Approx. 1 cable diameter	2"	6"	to maximum opening of E
82A3	1" to 1-7/16"	to fit connector	to fit connector	Approx. 1 cable diameter	2-1/2"	9"	to maximum opening of E

Additional Material Required:
Connector (except on AWG No. 10 or 8 in 82-A and 82-A1).

"S/L" means "SCOTCHLOK" Brand Connector. An extra "A" Size "UNIPAK" is advisable to have available for emer-

Scotchcast[®]

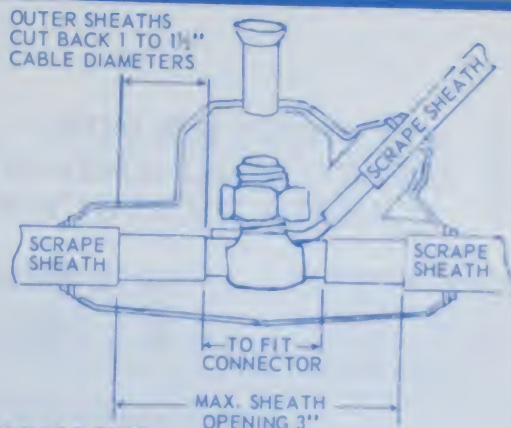
Splicing Kit
82-B1



CABLE O.D. RANGE - 1/4" TO 5/8"

Scotchcast[®]

Kit No. 90-B1
FOR CATHODIC PRO-
TECTION-MAX. 600 V.



CABLE O.D. RANGE -
FEEDER - 1/2" TO 1 1/4"
BRANCH - 1/2" TO 1 1/4"

4) Connectors

Good quality connectors with a smooth conforming shape are recommended. Bulky irregular shaped types should be avoided.

Apply one layer half-lapped of "SCOTCH" Brand tape #23 over the connector from pencil to pencil. Use if so designated in the kit instructions.

5) General hints when pouring the splice.

After the cable has been prepared and the connector installed, the split mold body is ready to be assembled. When trimming the ends of the molds, the hole should be made large enough so some clearance exists between the molds and the cable. If no clearance exists, it may be hard to snap the mold bodies together and the mold may leak resin. "SCOTCH" Brand #23 tape, supplied with the kit, is used for sealing the mold to the cable.

The conductor must be centered inside the mold body, because the splice will be no better than its minimum thickness insulation. Centering is easily checked with the transparent mold body.

Mix resin thoroughly as per instructions on the "UNIPAK" Brand Container. Care should be taken to clear the resin out of the corners of the bag when mixing.

The splice is now ready to be poured. Lay the splice in a horizontal position and pour resin in one of the spouts until resin fills all spouts. After the resin has warmed up and then cooled down and hardened the splice is ready to energize. Under normal conditions, the splice will cure up in 30 to 45 minutes. Do not move splice until resin hardens.

PART

3

PROCEDURE FOR SELECTING AND CONSTRUCTING A RESIN PRESSURE SPLICE



PROCEDURE FOR SELECTING AND CON- STRUCTING A Scotchcast RESIN PRESSURE SPLICE

- 1) When should a resin pressure splice be used?
Resin Pressure Splices (RPS) are used for making inline, wye, tee, and multi-conductor splices. When a "SCOTCHCAST" poured kit is not applicable for a splice, one should then consider resin splicing with the resin pressure method. With the resin pressure method, almost any size or shape splice can be made. As the flow of the resin is not dependent on gravity, the splice can be made in any position, including vertical. The voltage is presently limited to 7.5kv or less.
- 2) Select Drawing
Select the appropriate drawing for the kind of splice desired, cable construction, and voltage from Appendix A in back of book. If drawings do not apply to cable being spliced, contact your nearest 3M Representative.
- 3) Cable Preparation.
Prepare the cable ends to the dimensions shown in the appropriate drawing in Appendix A. Scrape the outer sheath clean by the method detailed in Part I under cable preparation. Remove the shielding tape where present to the length shown on appropriate drawing. Trim ends smooth and solder to hold its position. Remove all semi-conducting tape and residue from the primary insulation to position shown on drawing. Care must be exercised so that the primary insulation is not cut.
- 4) Connectors
Smooth compression or solder sleeve connectors are recommended in the mid-high voltage range. They are easily over-wrapped and result in a smooth, professional splice with good electrical stress distribution characteristics.
- 5) Building the splice
The P-3 spacer is wrapped to the specified thickness. It acts as a framework for the resin splice. Its designed porosity insures complete resin saturation.

The framework is first built up in the small diameter areas (connector, penciled area and insulation) to the level of the sheath.



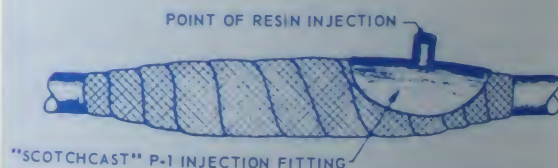
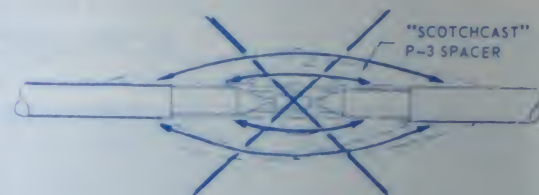
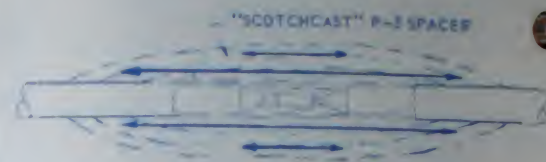
The spacer is then wound the full recommended length of the splice with the subsequent layers wound successfullly shorter, until the specified diameter and shape is reached. Winding in this manner produces good form, tapered ends, and eliminates uphill or downhill wrapping.

Caution: On shielded splices, do not extend the P-3 spacer over the shielding or semi-conducting tape.

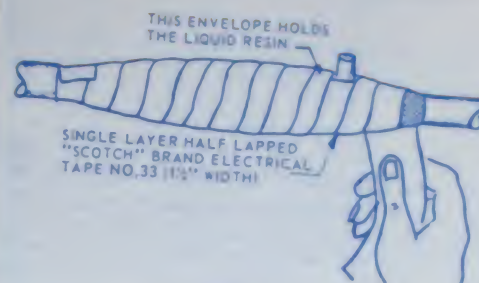
If the diameter is allowed to build up at the center first, all subsequent wrapping are either uphill or downhill, making good workmanship difficult. DO NOT buildup splice in this manner.

After the P-3 spacer has been built up to the recommended diameter, the P-1 injection fitting must be positioned. This fitting is located near one end of the splice. Position the spout for maximum convenience in fitting with the "SCOTCHCAST" Brand Resin Pressure Gun Model E-4.

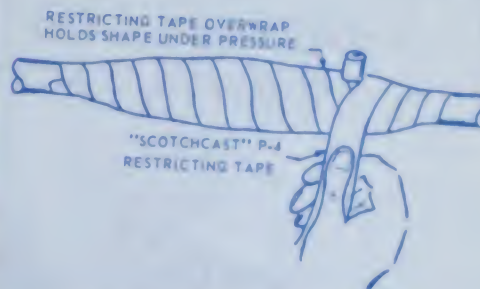
The injection fitting is held on the P-3 spacer with the use of 1-1/2 inch "SCOTCH" Brand #33 electrical tape. Start the first strip of tape on one side of the injection fitting and continue half-lapping beyond the end of the spacer. Start the second strip on the other side of the injection fitting and continue half-lapping over the other end of the spacer as shown at right.



When wrapping, pull the tape tightly so it will conform to the spacer buildup. If wrinkles appear in the tape envelope, possible resin leaks may result. The plastic tape envelope appears as shown at right.



The plastic tape envelope will stretch under pressure so it must be restricted during resin saturation. Two layers half-lapped of "SCOTCHCAST" Brand P-4 Restricting Tape (1" wide) firmly wrapped over the plastic tape envelope will restrict expansion of the envelope. Starting at one end of the splice, wrap one serving back to the starting point. The restricting tape may be removed after the splice has cured.

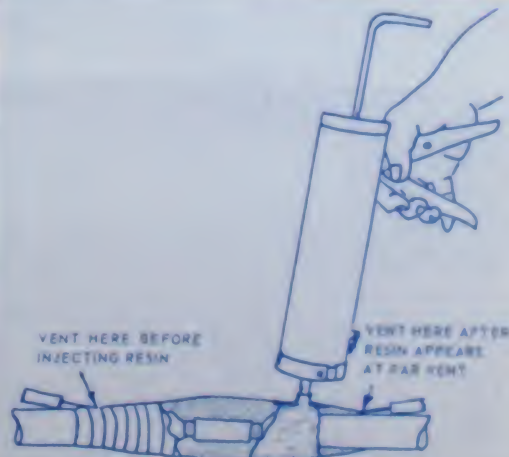


6) Saturating the splice.

Before resin injection, a vent hole is punctured through the envelope at the end farthest from the injection fitting. When venting, care must be taken not to puncture the cable insulation. Vent parallel with the axis of the cable as shown below, at right. Begin splice saturation with the resin pressure gun as per instructions in Part III.

Mix the resin in the "UNIPAK" Brand Container and load the "SCOTCHCAST" Brand Resin Pressure Gun Model E-4 as described in Part IV of this manual.

Because of the porosity of the P-3 spacer and the angle from which injection occurs, resin will first fill a cross sectional area of the splice. Acting as a piston, the resin forces air out of the vent. At this time, vent the envelope at the end closest to the injection fitting. Then continue injection until resin appears at the second vent. This is a simple effective method of expelling all the air from the splice.



NOTE: When splicing a multi-conductor cable or making a wye, tee, or shielded splice see Part V, Special Techniques, Page 17 of this book.

PART

4

MIXING RESIN,
LOADING AND INJECTING PROCEDURE

MIXING RESIN, LOADING AND INJECTING PROCEDURE

13

1. Mixing the Resin.

NOTE: When temperature is below 50°F, keep the resin in a warm place prior to mixing. For example, in an inside pocket next to body. Mix until the temperature of the resin starts to rise. This decreases the viscosity of the resin, and aids in pouring in cold weather.

- a. Take a firm pinch on EACH of the flat sides of the "UNIPAK" container near the center barrier. Pull bag sides apart and roll thumbs through the barrier.



- b. Alternately squeeze ends of the "UNIPAK" forcing contents rapidly back and forth.



- c. Strip contents from corners with thumb and forefinger. Mix until color is uniform (30 to 40 vigorous squeezes).



- d. Remove paper liner from a tape patch (packed with P-5 "UNIPAK" Piercing Nozzles.) Place hole in tape patch over P-5 Nozzle and center the assembly near the narrow edge of the mixed "UNIPAK".

2. LOADING THE RESIN PRESSURE GUN

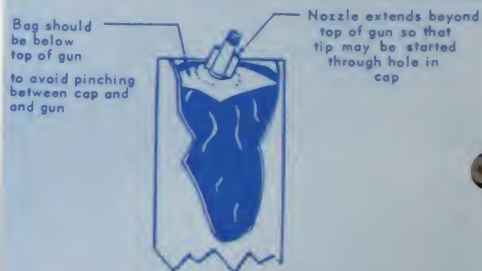
- a. Grasp the "UNIPAK" in both hands, holding it roughly cylindrical so it can easily slide into the gun barrel.
- b. Roll or bunch the end of the "UNIPAK" opposite the nozzle. This will force some resin toward the nozzle end and improve the cylindrical shape for loading.



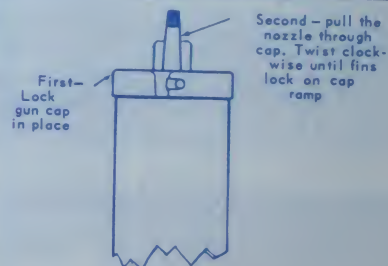
Roll or bunch this end. Resin is forced toward nozzle and makes holding easier.



- c. Slide the bag into the gun barrel. Work the handles so the nozzle tip sticks out of the barrel fold in any overlapping portions of the bag.



- d. Start the tip of the nozzle through the hole in gun cap. Lock gun cap in place.
- e. Pull nozzle until fins come completely through cap. Twist clockwise to lock nozzle to cap (fins engage cap ramps). Gun is now ready to use.



3. INJECTING RESIN INTO A SPLICE

- a. Lightly press the threaded tip of the nozzle into the P-1 Injection Fitting on the splice.

- b. Rotate entire gun 3 or 4 turns (clockwise) to engage nozzle firmly and form a liquid-tight coupling.
- c. Work gun handles until resistance is felt. A slight extra pressure on handles will cause the cutting edges of the nozzle to pierce the "UNIPAK" and permit resin to be pumped into the splice. Continue injecting resin until splice is full (droplets of resin appear at vent holes at the ends of the splice envelope).
- d. To remove gun from splice, release gun pressure, rotate entire gun counterclockwise to unscrew nozzle from fitting.

4. GENERAL HINTS ON INJECTING RESIN

- a. To unload gun, unlock gun cap and remove. Nozzle and bag assembly can then be easily unlocked from cap and discarded.
- b. When more than one "UNIPAK" is needed to fill a single splice, an assistant can prepare the next "UNIPAK" while the first is being injected.
- c. Wiping accidental drips or spills while the resin is still liquid is the easiest cleanup method. Wash hands thoroughly with soap and water.

PART

5

SPECIAL TECHNIQUES

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BrasStiff
splice2) Tee Sp
Prepa
spacer
mentio

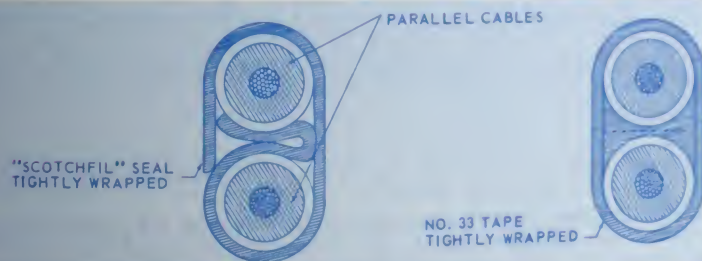
PART 5 SPECIAL TECHNIQUES

All types of resin pressure splices, regardless of size or configuration, follow the general procedure as described in Part II. This section discusses additional techniques in making wye, tee, shielded, multi-conductor splices, and sheath repair.

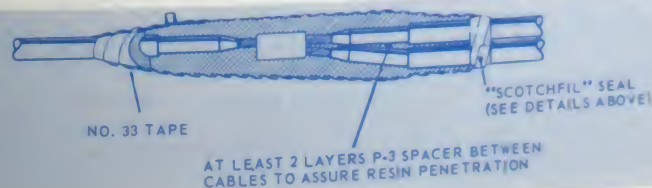
1) Parallel Wye Splice Unshielded.

When constructing a tap splice, first consideration should be given to constructing a wye splice. This splice is easier to make than a tee splice.

Prepare the cable as shown in the appropriate drawing in Appendix A. The tap and run cables come out of the splice side by side. At this point, the splice envelope must be sealed against resin leaks. Wrap a pad of 1/2" wide "SCOTCHFIL" Brand Insulation Putty between and around the cables as shown below. Tightly overwrap with "SCOTCH" Brand Electrical Tape #33.



Stuff two layers of P-3 spacer between the tap and run cables and continue to build up the splice as a single conductor cable.



2) Tee Splice Unshielded.

Prepare the cables to the appropriate dimensions as shown in Appendix A. Wrap the P-3 spacer to fit the configuration of the splice avoiding uphill or downhill wrappings as mentioned in Part II.

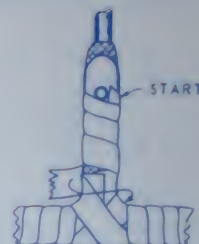
Apply the plastic tape envelope to the tee splice as shown.



STEP 1

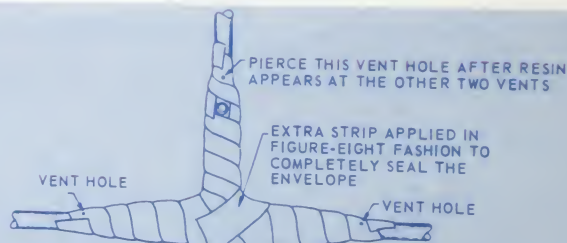


STEP 2



STEP 3

Overwrap the plastic tape envelope with "SCOTCHCAST" P-4 Restricting tape following the same wrapping procedure as shown above. The splice is now ready for saturation. Note the venting procedure shown in the illustration below:

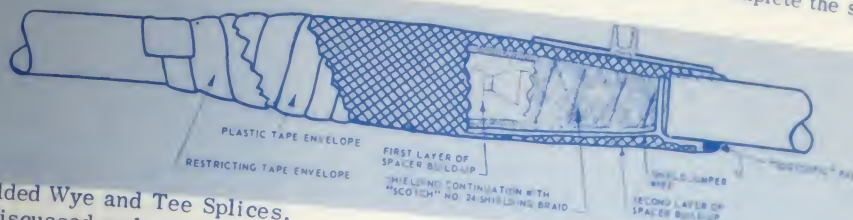


3) Shielded Inline Splices.

Special care should be taken not to cut into the primary insulation when preparing shielded cable. The end of the shielding should be smooth and free of irregularities that could cause points of high stress. Extend the semi-conducting tape 1/8" beyond the end of the shielding and scrape the interface clean as discussed in Part I. Pencil back the insulation, install the connector, and apply the first P-3 spacer buildup to the dimension shown in the appropriate drawing in Appendix A. The first P-3 spacer buildup should extend between the semi-conducting tape endings. It is important not to wrap over the semi-conducting tape onto the shielding.

Apply single layer half-lapped of "SCOTCH" Brand Shielding Tape No. 24 over first P-3 spacer buildup. The starting point should be on the shielding at one end of the splice opening and the ending point at the cable shielding at the opposite end. Tack solder the No. 24 tape to the shielding on both ends but do not run solder beads across the splice.

"SCOTCH" Brand #24 tape is designed for use in conjunction with a shielding jumper wire to restore full current carrying capacity of the cable shielding. A jumper wire soldered to both ends of the cable shielding should be brought out of the splice and grounded at this point.

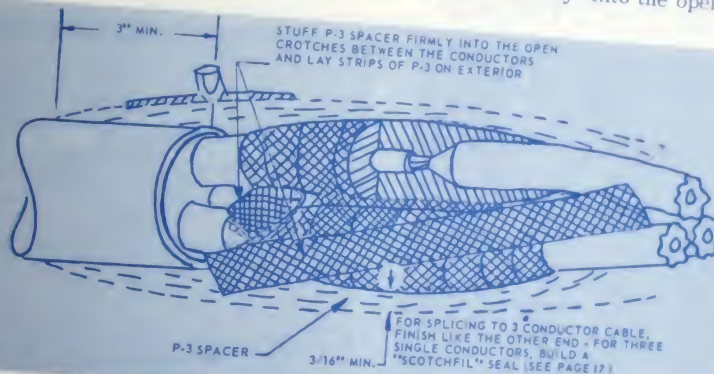


4) Shielded Wye and Tee Splices.

As discussed under shielded inline splices, let 1/8 inch of semi-conducting tape protrude from the ends of the shielding and begin first P-3 spacer buildup from this point. Apply "SCOTCH" Brand Shielding Tape No. 24 and shielding jumper wire by the method previously mentioned.

5) Unshielded Multi-Conductor Splices.

Prepare each conductor as a single conductor inline splice to the dimensions of the appropriate drawing in Appendix A. Wrap each conductor individually with P-3 spacer tape to the recommended diameter and stuff spacer firmly into the open spaces between conductors.



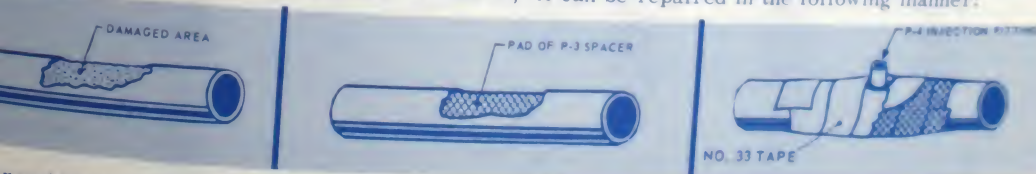
For splicing a 3 conductor cable to 3-individual conductors, see sketch above.

Lay cut strips of P-3 spacer on the exterior between each of the three wrapped legs to form a solid center before overwrapping entire splice.

Overwrap the entire splice with spacer and complete splice as previously discussed in Part II.

Sheath Repair.

The resin pressure technique is useful in repairing damaged cable sheath. If the damaged sheath has a section torn out, as shown, it can be repaired in the following manner:



roughly clean the sheath and the damaged area to remove resin adhesion. Form pad of spacer to neatly fit the damaged area.

Wrap several layers of P-3 spacer to a minimum 3/16" over damaged area and 3 inches beyond repair on both sides.

Locate the injection fitting, apply the plastic tape envelope, restricting tape, pierce vent holes and inject resin.

PART

6

Scotchcast
BRAND

TERMINATIONS


 PART
 TER
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(1) INTRODUCTION

 "SCOTCHCAST"
 strength
 insulator

(2) APPLICATIONS

 "SCOTCHCAST"
 placed
 at 24 ft

(3) WHICH

 There
 and two

 Kit
 No.

 63-A3
 63-B3
 63-A4
 63-B4

PART 6 TERMI- NATIONS

(1) INTRODUCTION

"SCOTCHCAST" Brand Terminations are made by using Type 83 Kits with pre-formed stress cones. This section will discuss the application of the Type 83 Kits. Installation instructions are omitted here, as each kit contains detailed instructions.

(2) APPLICATION RANGE

"SCOTCHCAST" Termination Kits can be used on rubber, synthetic, and thermoplastic insulated cables up to a maximum nominal rated voltage (phase to phase) of 20 KV.

Insulation diameter range:
0.62" to 1.54" (15.7 to 37.6 mm)
Maximum sheath diameter:
2.06" (54.0mm)

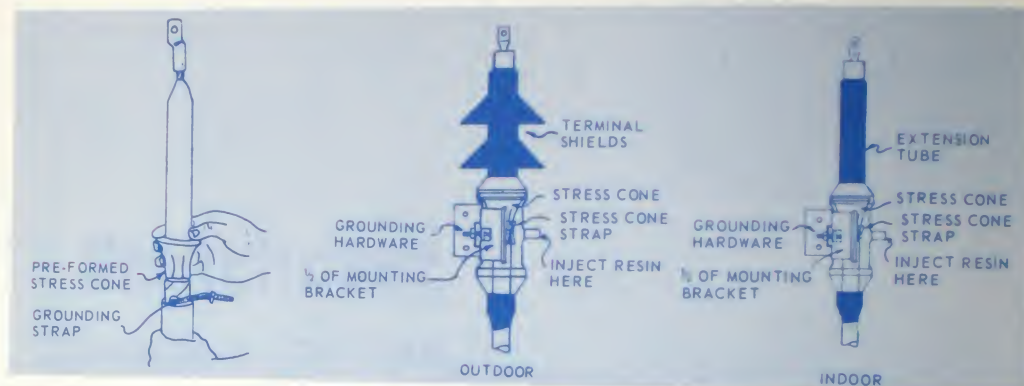
(3) WHICH KIT TO USE

There are four termination kits--two for indoor, or low conductive contaminate areas, and two for outdoor applications.

Kit No.	Type	Length	Max. Term. Dia.	Primary Insulation O.D.	Max. Sheath Dia.
83-A3	Outdoor	12"	4-1/2"	0.62" to 1.15"	1-7/16"
83-B3	Indoor	14"	2-1/2"	0.62" to 1.15"	1-7/16"
83-A4	Outdoor	14"	5-1/2"	1.15" to 1.54"	2.06"
83-B4	Indoor	15-1/2"	3"	1.15" to 1.54"	2.06"

(4) COMPONENTS

Each kit contains pre-formed stress cones, split mold bodies, terminal shields (for the outdoor area), or extension tube (for the indoor area), termination resin and the necessary components for installation on the cable end. Also included are brackets for mounting purposes.



NOTE: A "SCOTCHCAST" Brand Resin Pressure Gun Model E-4 is needed for resin injection.

(5) STRESS CONE KIT NO. 83-B1

The 83-B1 Stress Cone Kit is designed for use only on concentric neutral underground residential distribution (non-metallic shielded) cables. It provides an easy, economical and effective method of terminating the conductive sheath and a positive moisture seal of the critical stress relief area.

The 83-B1 kit is for use on cables where the nominal voltage rating (phase to phase) does not exceed 15 KV. It is for use in those pad mounted transformers where moisture, contamination and ultra-violet effects are not prevalent.

Insulation diameter range is $21/32"$ to $7/8"$
Cable O.D. range is $27/32"$ to $1-1/16"$ (not including external concentric conductors).

Each kit contains a complement of parts sufficient to construct and seal the stress relief area on two cables. 83-B1 utilizes the pre-formed stress cone, split mold bodies and "SCOTCHCAST" Brand Resin No. 4 in the convenient "UNIPAK" container as the insulating tool.

Installation instructions are omitted here, as each kit contains detailed instructions.



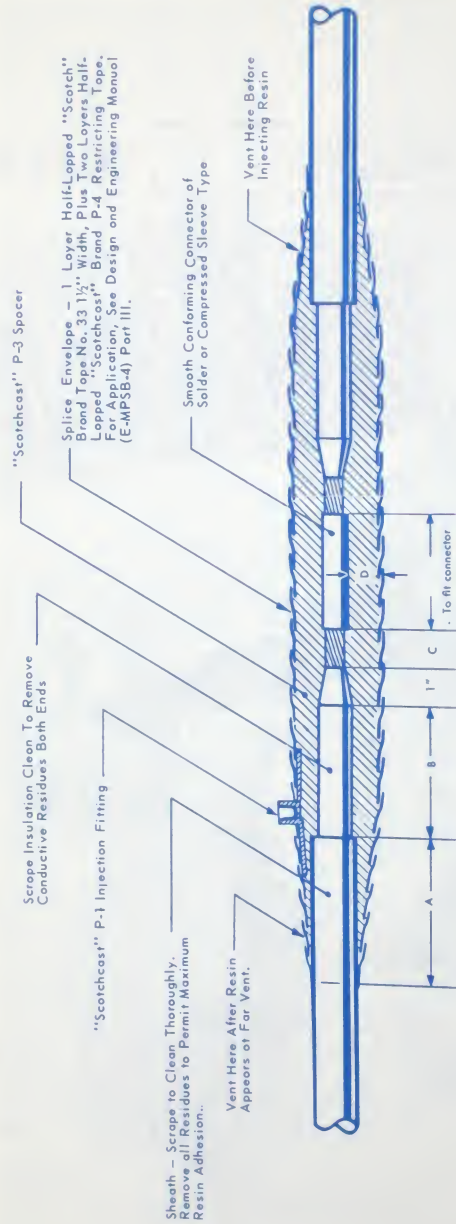
APPENDIX A

SPLICING?

THINK 3M!

<u>Title</u>	<u>Code No.</u>	<u>Page</u>
Inline Splice - Unshielded Cable 5 KV and Lower	E-MPD-3	24
Inline Splice - Shielded Cable 7-1/2 KV and Lower	E-MPD-4	25
Parallel Wye Splice - Unshielded Cable 5 KV and Lower	E-MPD-5	26
T-Splice - Unshielded Cable 5 KV and Lower	E-MPD-6	27
Inline Splice, Multi- Conductor 5 KV, Non-Shielded Cable	E-MPD-18	28
Inline Splice, 3 Conductor Armored, Shielded Cable 7.5 KV and Lower	E-MPD-19	29
Transition Splice of 3 Conductor Cable of 5KV and Lower Non-Shielded	E-MPD-20	30





CONSTRUCTION INFORMATION
FOR UNSHIELDED CABLES RATED 5000-VOLTS AND LOWER

CABLE SIZES	APPROX. CABLE INCHES	DIMENSIONS (INCHES)				MATERIALS REQUIRED FOR EACH SPLICE				
		A	B	C	D	"UNIPAK" SIZE "B" "C"	P-3 SPACER ROLLS	TAPE NO. 33 FEET	P-4 RESTRICTING TAPE ROLLS	P-5 PIERCING NOZZLE FITTINGS
14 AWG	65	3	3-18	1-2	3-8		1	8	1-2	1
16 AWG	72	3	3-18	1-2	3-8		1	8	1-2	1
18 AWG	75	3	3-18	3-4	3-8		1	8	1-2	1
20 AWG	79	3	3-18	3-4	3-8	1	1	8	1	1
22 AWG	84	3	3-18	3-4	3-8	1	1	8	1	1
24 AWG	89	3-1-4	3-1-4	3-4	3-8	1	1-1-2	10	1	1
26 AWG	98	3-1-4	3-1-4	3-4	7-16	1	1-1-2	10	1	1
28 AWG	106	3-1-4	3-1-4	1	7-16	1	2	10	1	1
30 AWG	111	3-1-4	3-1-4	1	7-16	1	2	12	1	2
32 AWG	116	3-1-4	3-1-2	1	7-16	1	2	12	1	2
34 AWG	121	3-1-2	3-1-2	1	7-16	1	2-1-2	15	1	2
36 AWG	130	3-3-4	3-1-2	1	7-16	1	2-1-2	15	1-1-2	2

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by good workmen, plus a safety factor. Splices should be constructed to shape and dimensions shown.

"SCOTCHCAST" Brand Resin No. 4

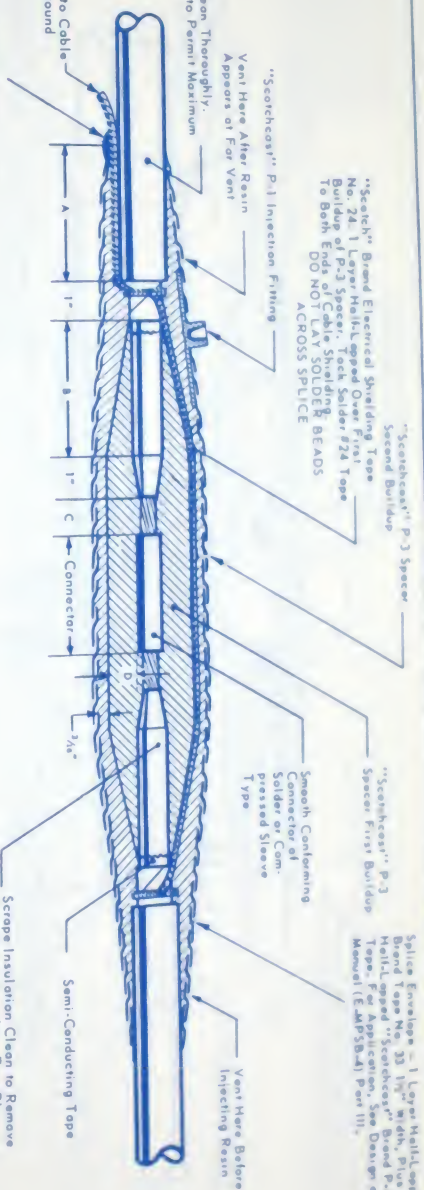
"SCOTCH", "SCOTCHCAST" and "UNIPAK" are trademarks of 3M Co.

TITLE: "SCOTCHCAST" Brand Resin Pressure
Inline Splice - Unshielded Cable
5 KV and Lower

3M MINNESOTA MINING & MANUFACTURING CO

E-MPD-3

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Scotchfil Brand Seal, Overwrapped with **Scotch** Brand Tape No. 33 or 88. For Application, See Design and Engineering Manual (E-MP5B-4) Part IV.

FOR SHIELDED CABLES RATED 7500 VOLTS (GROUND NEUTRAL)

CONSTRUCTION INFORMATION

FOR SHIELDED CABLES RATED 5000 VOLTS AND LOWER

CABLE SIZE	APPROX CABLE O.D. INCHES	DIMENSIONS (INCHES)				MATERIALS REQUIRED FOR EACH SPLICE							
		A	B	C	D	"UNIPAK" SIZE "B" "C"	P-3 SPACER MOLES	TAPE NO. 33 RESTRICTING TAPE MOLES	P-4 RESTRICTING MOLES	P-5 INJECTING FITTINGS	TAPE RESTRICTING TAPE MOLES		
1/4 ANG	90	3	5	1.2	5.8	1	1	3	21	1-1/2	2	1	18
7/16 ANG	96	3	5	1.2	5.8	1	1	3	21	1-1/2	2	1	18
1/2 ANG	100	3	5	3/4	5.8	1	1	3	21	1-1/2	2	1	18
5/8 ANG	104	3	5	3/4	5.8	2	3	21	1-1/2	2	1	18	
3/4 ANG	108	3	5	3/4	5.8	2	3	21	1-1/2	2	1	18	
7/8 ANG	112	3	5	3/4	5.8	2	3	24	2	2	1	18	
1 ANG	116	3	5	3/4	5.8	2	3	24	2	2	1	18	
1 1/8 ANG	120	3	5	3/4	5.8	2	4	27	2	2	1	18	
1 1/4 ANG	124	3	5	1	5.8	2	4	27	2	2	1	18	
1 1/2 ANG	128	3	5	1	5.8	2	4	27	2	2	1	18	
1 3/4 ANG	132	3	5	1	5.8	2	4	27	2	2	1	18	
2 ANG	136	3	5	1	5.8	2	4	27	2	2	1	18	
2 1/4 ANG	140	3	5	1	5.8	2	4	27	2	2	1	18	
2 1/2 ANG	144	3	5	1	5.8	2	4	27	2	2	1	18	
2 3/4 ANG	148	3	5	1	5.8	2	4	27	2	2	1	18	
3 ANG	152	3	5	1	5.8	2	4	27	2	2	1	18	
3 1/4 ANG	156	3	5	1	5.8	2	4	27	2	2	1	18	
3 1/2 ANG	160	3	5	1	5.8	2	4	27	2	2	1	18	
3 3/4 ANG	164	3	5	1	5.8	2	4	27	2	2	1	18	
4 ANG	168	3	5	1	5.8	2	4	27	2	2	1	18	
4 1/4 ANG	172	3	5	1	5.8	2	4	27	2	2	1	18	
4 1/2 ANG	176	3	5	1	5.8	2	4	27	2	2	1	18	
4 3/4 ANG	180	3	5	1	5.8	2	4	27	2	2	1	18	
5 ANG	184	3	5	1	5.8	2	4	27	2	2	1	18	
5 1/4 ANG	188	3	5	1	5.8	2	4	27	2	2	1	18	
5 1/2 ANG	192	3	5	1	5.8	2	4	27	2	2	1	18	
5 3/4 ANG	196	3	5	1	5.8	2	4	27	2	2	1	18	
6 ANG	200	3	5	1	5.8	2	4	27	2	2	1	18	
6 1/4 ANG	204	3	5	1	5.8	2	4	27	2	2	1	18	
6 1/2 ANG	208	3	5	1	5.8	2	4	27	2	2	1	18	
6 3/4 ANG	212	3	5	1	5.8	2	4	27	2	2	1	18	
7 ANG	216	3	5	1	5.8	2	4	27	2	2	1	18	
7 1/4 ANG	220	3	5	1	5.8	2	4	27	2	2	1	18	
7 1/2 ANG	224	3	5	1	5.8	2	4	27	2	2	1	18	
7 3/4 ANG	228	3	5	1	5.8	2	4	27	2	2	1	18	
8 ANG	232	3	5	1	5.8	2	4	27	2	2	1	18	
8 1/4 ANG	236	3	5	1	5.8	2	4	27	2	2	1	18	
8 1/2 ANG	240	3	5	1	5.8	2	4	27	2	2	1	18	
8 3/4 ANG	244	3	5	1	5.8	2	4	27	2	2	1	18	
9 ANG	248	3	5	1	5.8	2	4	27	2	2	1	18	
9 1/4 ANG	252	3	5	1	5.8	2	4	27	2	2	1	18	
9 1/2 ANG	256	3	5	1	5.8	2	4	27	2	2	1	18	
9 3/4 ANG	260	3	5	1	5.8	2	4	27	2	2	1	18	
10 ANG	264	3	5	1	5.8	2	4	27	2	2	1	18	
10 1/4 ANG	268	3	5	1	5.8	2	4	27	2	2	1	18	
10 1/2 ANG	272	3	5	1	5.8	2	4	27	2	2	1	18	
10 3/4 ANG	276	3	5	1	5.8	2	4	27	2	2	1	18	
11 ANG	280	3	5	1	5.8	2	4	27	2	2	1	18	
11 1/4 ANG	284	3	5	1	5.8	2	4	27	2	2	1	18	
11 1/2 ANG	288	3	5	1	5.8	2	4	27	2	2	1	18	
11 3/4 ANG	292	3	5	1	5.8	2	4	27	2	2	1	18	
12 ANG	296	3	5	1	5.8	2	4	27	2	2	1	18	
12 1/4 ANG	300	3	5	1	5.8	2	4	27	2	2	1	18	
12 1/2 ANG	304	3	5	1	5.8	2	4	27	2	2	1	18	
12 3/4 ANG	308	3	5	1	5.8	2	4	27	2	2	1	18	
13 ANG	312	3	5	1	5.8	2	4	27	2	2	1	18	
13 1/4 ANG	316	3	5	1	5.8	2	4	27	2	2	1	18	
13 1/2 ANG	320	3	5	1	5.8	2	4	27	2	2	1	18	
13 3/4 ANG	324	3	5	1	5.8	2	4	27	2	2	1	18	
14 ANG	328	3	5	1	5.8	2	4	27	2	2	1	18	
14 1/4 ANG	332	3	5	1	5.8	2	4	27	2	2	1	18	
14 1/2 ANG	336	3	5	1	5.8	2	4	27	2	2	1	18	
14 3/4 ANG	340	3	5	1	5.8	2	4	27	2	2	1	18	
15 ANG	344	3	5	1	5.8	2	4	27	2	2	1	18	
15 1/4 ANG	348	3	5	1	5.8	2	4	27	2	2	1	18	
15 1/2 ANG	352	3	5	1	5.8	2	4	27	2	2	1	18	
15 3/4 ANG	356	3	5	1	5.8	2	4	27	2	2	1	18	
16 ANG	360	3	5	1	5.8	2	4	27	2	2	1	18	
16 1/4 ANG	364	3	5	1	5.8	2	4	27	2	2	1	18	
16 1/2 ANG	368	3	5	1	5.8	2	4	27	2	2	1	18	
16 3/4 ANG	372	3	5	1	5.8	2	4	27	2	2	1	18	
17 ANG	376	3	5	1	5.8	2	4	27	2	2	1	18	
17 1/4 ANG	380	3	5	1	5.8	2	4	27	2	2	1	18	
17 1/2 ANG	384	3	5	1	5.8	2	4	27	2	2	1	18	
17 3/4 ANG	388	3	5	1	5.8	2	4	27	2	2	1	18	
18 ANG	392	3	5	1	5.8	2	4	27	2	2	1	18	
18 1/4 ANG	396	3	5	1	5.8	2	4	27	2	2	1	18	
18 1/2 ANG	400	3	5	1	5.8	2	4	27	2	2	1	18	
18 3/4 ANG	404	3	5	1	5.8	2	4	27	2	2	1	18	
19 ANG	408	3	5	1	5.8	2	4	27	2	2	1	18	
19 1/4 ANG	412	3	5	1	5.8	2	4	27	2	2	1	18	
19 1/2 ANG	416	3	5	1	5.8	2	4	27	2	2	1	18	
19 3/4 ANG	420	3	5	1	5.8	2	4	27	2	2	1	18	
20 ANG	424	3	5	1	5.8	2	4	27	2	2	1	18	
20 1/4 ANG	428	3	5	1	5.8	2	4	27	2	2	1	18	
20 1/2 ANG	432	3	5	1	5.8	2	4	27	2	2	1	18	
20 3/4 ANG	436	3	5	1	5.8	2	4	27	2	2	1	18	
21 ANG	440	3	5	1	5.8	2	4	27	2	2	1	18	
21 1/4 ANG	444	3	5	1	5.8	2	4	27	2	2	1	18	
21 1/2 ANG	448	3	5	1	5.8	2	4	27	2	2	1	18	
21 3/4 ANG	452	3	5	1	5.8	2	4	27	2	2	1	18	
22 ANG	456	3	5	1	5.8	2	4	27	2	2	1	18	
22 1/4 ANG	460	3	5	1	5.8	2	4	27	2	2	1	18	
22 1/2 ANG	464	3	5	1	5.8	2	4	27	2	2	1	18	
22 3/4 ANG	468	3	5	1	5.8	2	4	27	2	2	1	18	
23 ANG	472	3	5	1	5.8	2	4	27	2	2	1	18	
23 1/4 ANG	476	3	5	1	5.8	2	4	27	2	2	1	18	
23 1/2 ANG	480	3	5	1	5.8	2	4	27	2	2	1	18	
23 3/4 ANG	484	3	5	1	5.8	2	4	27	2	2	1	18	
24 ANG	488	3	5	1	5.8	2	4	27	2	2	1	18	
24 1/4 ANG	492	3	5	1	5.8	2	4	27	2	2	1	18	
24 1/2 ANG	496	3	5	1	5.8	2	4	27	2	2	1	18	
24 3/4 ANG	500	3	5	1	5.8	2	4	27	2	2	1	18	

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by good workmen, plus a safety factor. Splices should be constructed to shape and dimensions shown.

SCOTCHCAST Brand Resin No. 4

SCOTCH **SCOTCHCAST** **SCOTCHFIL** and **UNIPAK** are trademarks of 3M Co

TITLE: **SCOTCHCAST** Brand Resin Pressure

Inline Splice - Shielded Cable
7 1/2 KV and Lower

3M MINNESOTA MINING & MANUFACTURING CO
E-MPD-4



Scrape Insulation Clean to Remove Conductive Residues - Three Ends.

CONSTRUCTION INFORMATION
FOR UNSHIELDED CABLES RATED 5000 VOLTS AND LOWER

APPROX CABLE SIZE O.D. INCHES		DIMENSION (INCHES)						MATERIALS REQUIRED FOR EACH SPLICE						
		A		B		C		UNPAK'S...		P-3		P-5		P-1
								SIZE "B"	SIZE "C"	SPACER ROLLS	NO. TAPS ROLLS	INJECTION ROLLS	PIERCING NOZZLE	
1/4" ANG	65	3	3 1/8	1 1/2	3/8	1	1 1/2	12	1	1	1	1	1	1
1/2" ANG	72	3	3 1/8	1 1/2	3/8	1	1 1/2	12	1	1	1	1	1	1
3/4" ANG	75	3	3 1/8	3/4	3/8	1	1 1/2	12	1	1	1	1	1	1
1" ANG	79	3	3 1/8	3/4	3/8	1	1 1/2	12	1 1/2	2	1	1	1	1
2" ANG	84	3	3 1/8	3/4	3/8	1	2	12	1 1/2	2	1	1	1	1
3" ANG	89	3 1/4	3 1/4	3/4	3/8	2	2 1/2	15	1 1/2	2	1	1	1	1
4" ANG	98	3 1/4	3 1/4	3/4	7/16	2	2 1/2	15	1 1/2	2	1	1	1	1
250 MCM	106	3 1/4	3 1/4	1	7/16	2	3	15	1 1/2	2	1	1	1	1
300 MCM	111	3 1/4	3 1/4	1	7/16	2	2	18	2	2	1	1	1	1
350 MCM	116	3 1/4	3 1/4	1	7/16	1	2	3 1/2	18	2	3	1	1	1
400 MCM	121	3 1/2	3 1/2	1	7/16	1	2	4	25	2 1/2	3	1	1	1
500 MCM	130	3 3/4	3 1/2	1	7/16	2	4	25	2 1/2	3	1	1	1	1

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DATE 08-01-2001 BY 60322 UCBAW/SJS/STP

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by good workmen, plus a safety factor. Splices should be constructed to shape and dimensions shown.

* "SCOTCHCAST" Brand Resin No. 4

TITLE: "SCOTCHCAST" Brand Resin Pressure
Parallel Wye Splice - Unshielded Cable
5 KV and Lower

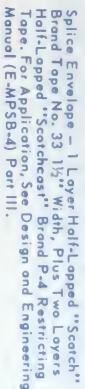
3M MINNESOTA MINING & MANUFACTURING CO.

E-MPD-5

"SCOTCH", "SCOTCHCAST", "SCOTCHFIL" and "UNIPAK" are trademarks of 3M Co.

F-MPO-5(123.1)R

TITLE SCOTCHCAST[®] Diamond Resin Procedure
T Splice Unshielded Cable
3 N V end lower

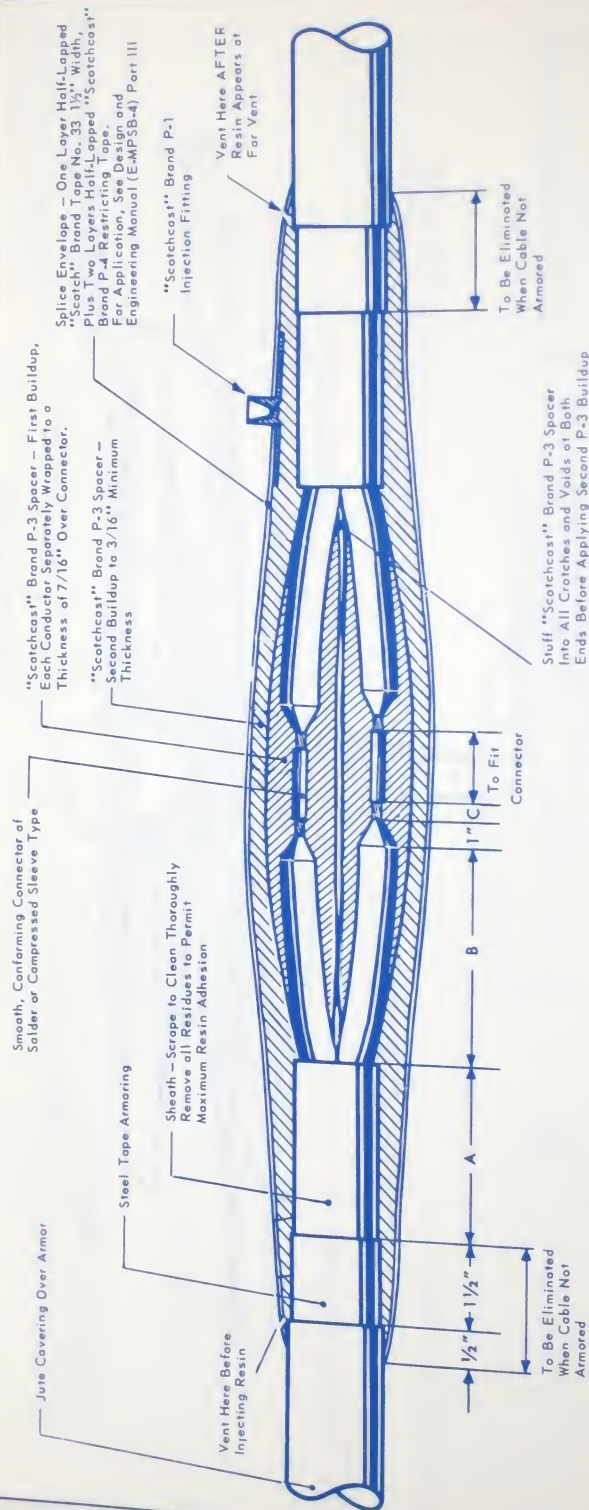


NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by good workmen, plus a safety factor. Splices should be constructed to shape and dimensions shown.

MATERIALS REQUIRED FOR EACH PULCE															
SIZE CABLE INCHES	APPROX CABLE O.D. INCHES	DIMENSION (INCHES)				UNIPACKS...			P-3 TYRE INCHES					P-5 PIERCING NOZZLE	P-1 INJECTION FITTING
		A	B	C	D	"B"	SIZE "C"	P-3 SPACER ROLLS	TYRE INCHES	P-4 ROLLS					
12 ANG	65	3	31.8	12	3.8	1	11.2	18	11.2	1	1	1	1	1	
14 ANG	72	3	31.8	12	3.8	1	11.2	18	11.2	1	1	1	1	1	
11 ANG	75	3	31.8	34	3.8	1	2	18	2	2	1	1	1	1	
11.6 ANG	79	3	31.8	34	3.8	1	2	18	2	2	1	1	1	1	
2.6 ANG	84	3	31.8	34	3.8	1	2	18	2	2	1	1	1	1	
3.6 ANG	89	3	31.8	34	3.8	1	2	21.2	20	2	2	1	1	1	
4.6 ANG	96	3	31.8	34	3.8	1	2	20	2	2	2	1	1	1	
250 MCH	106	3	31.8	34	3.8	1	2	21.2	24	2	2	1	1	1	
300 MCH	111	3	31.8	34	3.8	1	2	21.2	24	2	2	1	1	1	
350 MCH	116	3	31.8	34	3.8	1	2	21.2	24	2	2	1	1	1	
400 MCH	121	3	31.8	34	3.8	1	2	21.2	24	2	2	1	1	1	
500 MCH	130	3	31.8	34	3.8	1	2	21.2	24	2	2	1	1	1	

[illegible]

TITLE:
"SCOTCHEAST" Brand Resin Pressure
T-Splice - Unshielded Cable
5 KV and Lower



CONSTRUCTION INFORMATION
3 CONDUCTOR, SKV, NON-SHIELDED CABLE

CABLE SIZE	APPROX. O.D. OVER SHEATH - INCHES	OIL PAPER	OTHER	DIMENSIONS - INCHES			UNIPAK MATERIALS REQUIRED PER SPLICE		
				A	B	C	SIZE	SPACE	P.T.
AWG	MM ²	MM ²	MM ²	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES
8	8.3	1.11	1.26	3	3.14	3	1.4	1	1.5
6	13.3	1.21	1.40	3	3.14	3	1.4	1	2.0
4	21.2	1.29	1.50	3	3.12	3.18	1.2	1	2.5
2	33.6	1.39	1.63	3	3.34	3.18	1.2	2	3.0
1	42.4	1.45	1.74	3	4	3.18	3.4	1	3.5
10	59.5	1.54	1.89	3	4.14	3.18	3.4	1	4.0
20	67.8	1.55	1.93	3	4.12	3.18	3.4	3	4.0
30	85.0	1.57	2.04	3.14	4.12	3.14	3.4	3	4.0
40	107.2	1.59	2.17	3.14	4.12	3.14	3.4	3	4.0
250	126.7	1.60	2.27	3.14	4.34	3.14	3.4	1	4.5
300	152.0	1.69	2.49	3.14	5	3.14	1	4	5.0
350	177.3	1.77	2.59	3.14	5	3.12	1	4	5.5
400	202.1	1.85	2.70	3.12	5	3.12	1	5	6.0
500	253.4	2.01	2.88	3.24	5	3.12	1	5	7.0
									35
									25
									6

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by good workmen plus a safety factor. Splices should be constructed to shape and dimensions shown.

* "SCOTCHCAST" Brand Resin No. 4

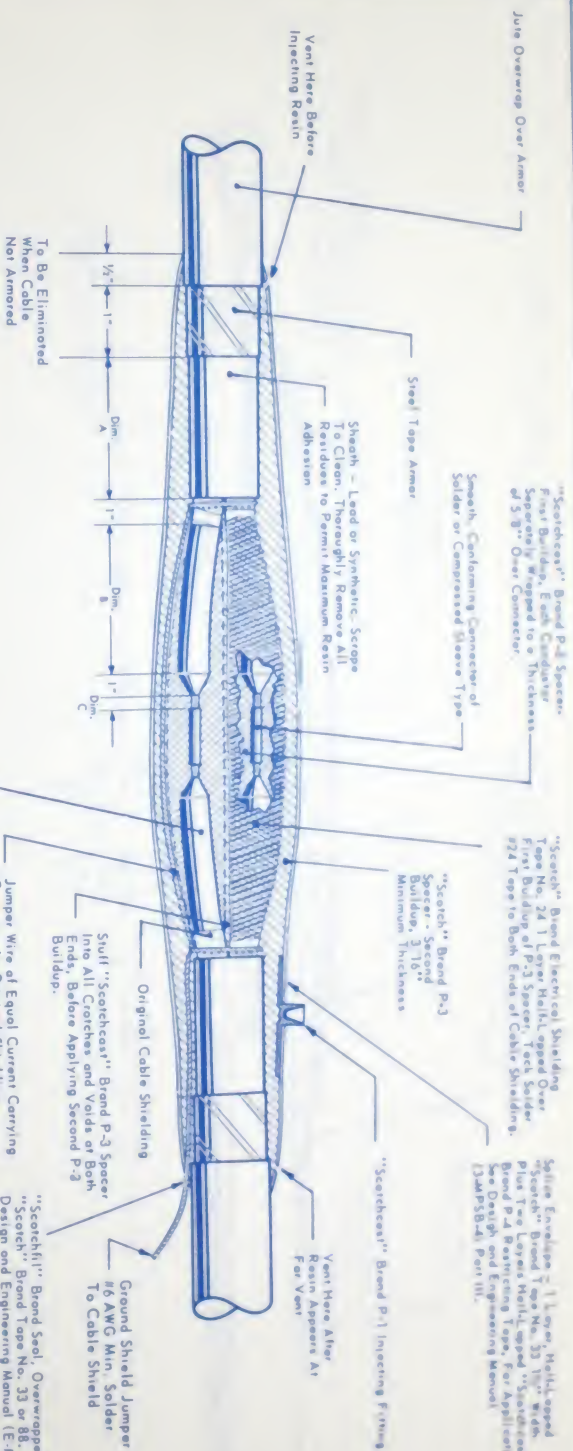
"SCOTCH", "SCOTCHCAST" and "UNIPAK" are trademarks of 3M Co.

TITLE

"SCOTCHCAST" Brand Resin Pressure
Inline Splice, Multi Conductor SKV
Non-Shielded Cable

3M MINNESOTA MINING & MANUFACTURING CO.

E-MPD-18



3. CONDUCTOR 7.5 KV SHIELDED ARMORED

Cable Size AWG MCM	Approx. OD Over Sheath in mm ² Paper Other	Dimensions-Inches			"Unbolt"		Materials Required For Splice						
		A	B Oil Paper and Other	C	SIZE "B"	SIZE "C"	P-3 Spacer Feet	Ne-33 Feet	No 24 Tape Rolls	P-4 Pressing Nozzle	P-5 Pressing Fitting		
8	8.3	1.11	1.26	3	1	1	2.5	12	4	1	1	1	
6	13.3	1.21	1.40	3	1 1/2	1	3.0	13	4	1	1	1	
4	21.2	1.29	1.50	3	1 1/2	1	4 1/2	40	5	3	3	1	
2	33.6	1.39	1.63	3	1 1/2	1	4 1/2	40	5	3	3	1	
1	42.4	1.45	1.74	3	1 1/2	1	4 1/2	40	5	3	3	1	
1/0	53.5	1.54	1.83	3	1 1/2	1	4 1/2	45	5	3	3	1	
2/0	67.8	1.55	1.93	3 1/4	1 1/2	1	5	50	6	3	3	1	
3/0	85.0	1.57	2.04	3 1/4	1 1/2	1	5	50	6	4	3	1	
4/0	107.2	1.59	2.17	3 1/2	1 1/2	1	5	50	6	4	3	1	
250	126.7	1.60	2.37	3 1/2	1 1/2	1	6	55	6	4	4	1	
300	152.0	1.69	2.49	3 1/2	1 1/2	1	6	55	6	4	4	1	
350	177.3	1.77	2.59	3 1/2	1 1/2	1	7	55	7	4	4	1	
400	202.7	1.85	2.70	3 1/2	1 1/2	1	7	60	7	5	4	1	
500	253.4	2.01	2.88	3 1/2	1 1/2	1	7 1/2	60	7	5	4	1	

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by good workmen, plus a safety factor. Splices should be constructed to shape and dimensions shown.

"SCOTCHCAST" Brand Resin No. 4

"SCOTCH" Brand Tape No. 24, 15 Ft. Roll

"SCOTCH", "SCOTCHCAST", "SCOTCHFIL" and "UNIPAK" are trademarks of 3M Co.

TITLE

"SCOTCHCAST" Brand Resin Pressure
Injection Splice, 3 Conductor Armored
Shielded Cable 7.5 KV and Lower

3M MINNESOTA MINING & MANUFACTURING CO
E-MPD-19

As a corporation, 3M Company, is not a party to this contract. It is the responsibility of the contractor to obtain all necessary permits and licenses and to comply with all applicable laws, regulations, and codes. The contractor shall be responsible for the proper installation and use of the product. The contractor shall be responsible for the proper disposal of any waste material. The contractor shall be responsible for the proper handling and storage of the product. The contractor shall be responsible for the proper use of the product. The contractor shall be responsible for the proper maintenance of the product. The contractor shall be responsible for the proper repair of the product. The contractor shall be responsible for the proper replacement of the product. The contractor shall be responsible for the proper removal of the product. The contractor shall be responsible for the proper installation of the product. The contractor shall be responsible for the proper use of the product. The contractor shall be responsible for the proper maintenance of the product. The contractor shall be responsible for the proper repair of the product. The contractor shall be responsible for the proper replacement of the product. The contractor shall be responsible for the proper removal of the product.

"Scotchfil" Brand Seal, Overwrapped with
"Scotch" Brand Tape No. 33 or 88. See
Design and Engineering Manual (E-MPS-B-4)
Part IV.

Original Cable Insulation - Remove Semi-Conducting Tape to "w"
in Front of Shielding (If Any) and Scope Clean of Any Residue.

Jumpers of Equal Current Carrying
Capacity As Original Shielding

Suit "Scotchcast" Brand P-3 Spacer
Into All Crotchings and Voids of Both
Ends, Before Applying Second P-3
Building.

Original Cable Shielding

Ground Shield Jumper
#6 AWG Min. Solder
To Cable Shield

"Scotch" Brand P-3
Spacer - Second
Building, 3rd
Minimum Thickness

"Scotch" Brand Electrical Shielding
Tape No. 24 1 Layer Half-Lapped Over
First Building of P-3 Spacer. See Section
P-24 1 Tape to Both Ends of Cable Shielding.

Splice Enclosure - 1 Layer, Half-Lapped
"Scotch" Brand Tape No. 33 1/2" width,
Plus Two Layers Half-Lapped "Scotchcast"
Brand P-4 Reinforcing Tape, for Application,
See Design and Engineering Manual
(J-MPS-B-4) Part III.

"Scotchcast" Brand P-4 Spacer
Buildup, 3rd Building, 3rd
Minimum Thickness

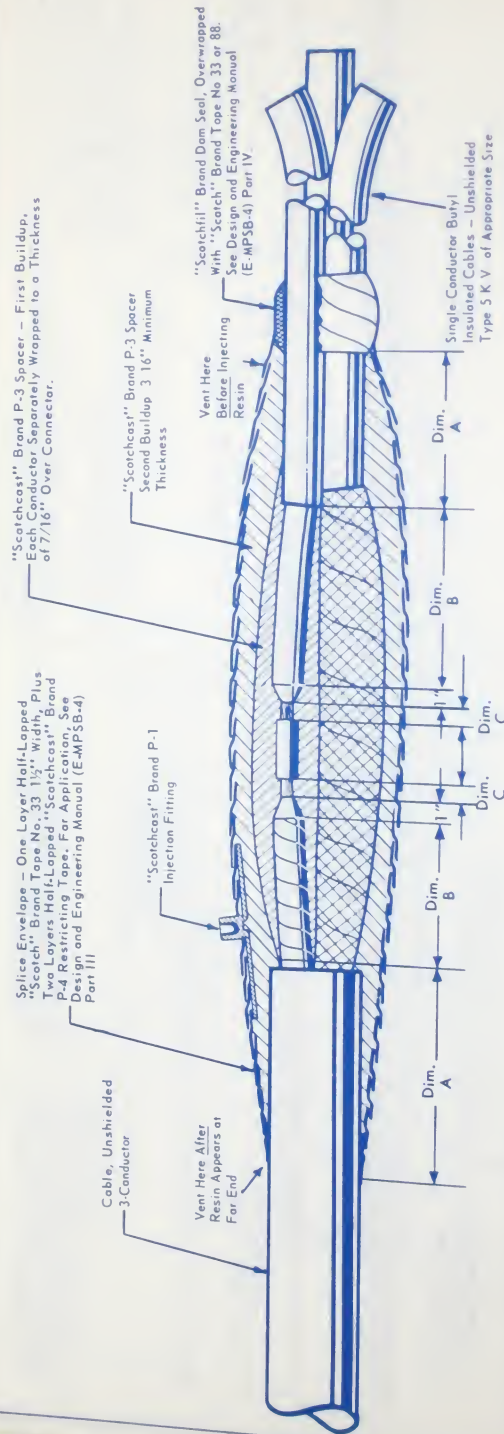
Solder or Compressed Sleeve Type

Steel Tape Armor

Sheath - Lead or Synthetic. Scope
To Clean. Thoroughly Remove All
Residues to Permit Maximum Resin
Adhesion

Vent Here Before
Injecting Resin

To Be Eliminated
When Cable
Not Armored



CONSTRUCTION INFORMATION
3-CONDUCTOR, 5 KV, NON-SHIELDED

3-CONDUCTOR, 3-KV, RUN-INSHIELDED														
Cable Size			Approx. OD Over Sheath-In.			Dimensions-Inches			"Unpak..."		Materials Required Per Splice			
						A	B		C	SIZE "B"	SIZE "C"	P-3 Spacer Rolls	No. 33 Type Feet	P-4 Resin Rolls
AWG	mm ²		Oil Paper Other	Oil Paper Other										
8	8.3	1.11	1.26	3	3-1/4	3	1-4	1	2.5	12	1	1	1	1
6	13.3	1.21	1.40	3	3-1/4	3	1-4	1	3.0	13	1	1	1	1
4	21.2	1.29	1.50	3	3-1/2	3-1/8	1-2	1	3.0	14	2	2	1	1
2	33.6	1.39	1.63	3	3-3/4	3-1/8	1-2	2	3.5	15	1	2	1	1
1	42.4	1.45	1.74	3	4	3-1/8	3-4	2	4	16	1	2	1	1
10	53.5	1.54	1.83	3	4-1/4	3-1/8	3-4	2	4	17	1	2	1	1
20	67.8	1.55	1.93	3	4-1/2	3-1/8	3-4	1	2	4.5	18	1.5	3	1
30	85.0	1.57	2.04	3-1/4	4-1/2	3-1/4	3-4	1	2	5	19	1.5	3	1
40	107.2	1.59	2.17	3-1/4	4-1/2	3-1/4	3-4	1	3	6	21	1.5	3	1
250	126.7	1.60	2.37	3-1/4	4-3/4	3-1/4	1	1	3	6.5	22	1.5	4	1
300	152.0	1.69	2.49	3-1/4	5	3-1/4	1	1	3	7	23	2	4	1
350	177.3	1.77	2.59	3-1/4	5	3-1/2	1	1	4	8	25	2.5	4	1
400	202.7	1.85	2.70	3-1/2	5	3-1/2	1	1	4	8.5	27	2.5	5	1
500	253.4	2.01	2.88	3-3/4	5	3-1/2	1	1	5	9	29	2.5	5	1

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by good workmen, plus a safety factor. Splices should be constructed to shape and dimensions shown.

"SCOTCH", "SCOTCHCAST", "SCOTCHFIL" and "UNIPAK" are trademarks of 3M Co.

TITLE: "SCOTCHCAST" Brand Resin Pressure
Transition Splice of 3-Conductor Cable
of 5 KV and Lower Rating, Non-Shielded

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, express or implied:

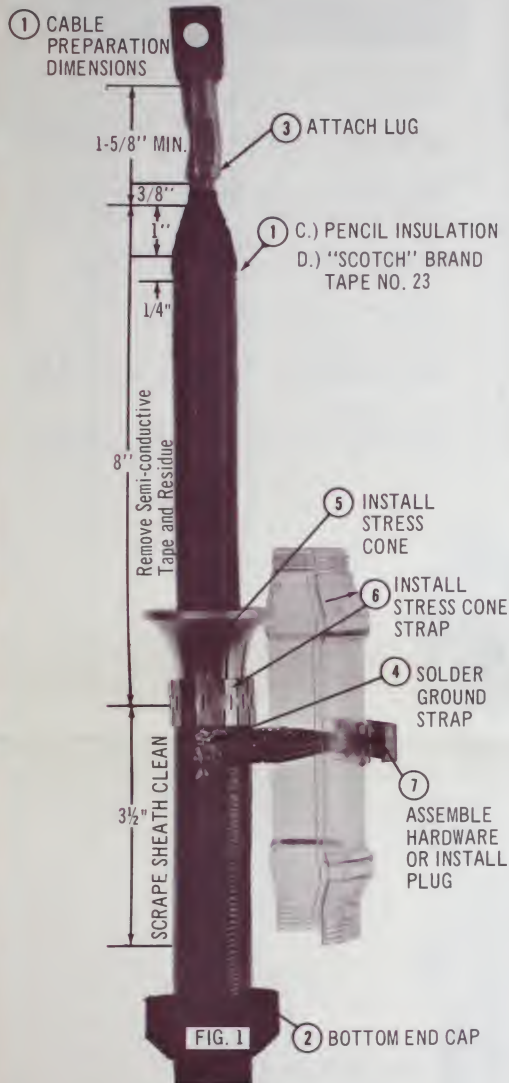
Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct or consequential, arising out of the use or the inability to use the product. Before using, user shall determine the suitability of the product for his intended use, and user assumes all risk and liability whatsoever in connection therewith.

No statement or recommendation not contained herein shall have any force or effect unless in an agreement signed by officers of seller and manufacturer.

3M **Electrical Products Division**
MINNESOTA MINING & MANUFACTURING CO.







FOLLOW THIS STEP-BY-STEP PROCEDURE:

- 1 CABLE PREPARATION - Use exact dimensions as shown at left of Fig. 1

(a) Remove lead sheath to dimensions as shown.

NOTE: If cable is shielded or has semi-conductive tape, leave 1/8" of shielding or semi-conducting tape in front of lead sheath.

CAUTION: ALL THREADS AND RESIDUE FROM SEMI-CONDUCTIVE TAPE MUST BE REMOVED. DO NOT CUT INSULATION WHEN REMOVING SHEATH OR SHIELDING.

(b) CLEAN SHEATH by scraping with a knife or rasp. DO NOT USE SOLVENTS.

(c) PENCIL INSULATION on conductor 1" as shown in Fig. 1.

(d) APPLY one layer half-lapped of "SCOTCH" Brand Tape No. 23 (supplied with kit) over penciled area for oil seal.

- 2 BOTTOM END CAP - CUT HOLE IN BOTTOM END CAP SLIGHTLY LARGER THAN CABLE



FIG. 2

NOTE: If a conductor lug or terminal pin is NOT used at the dimensions shown in Fig. 1, the conductor strands must be soldered completely closed for a minimum distance of 2 inches above the cable insulation.

CAUTION: CLEAN ALL DIRT AND OIL FROM CONDUCTOR.

- 4 SOLDER GROUND STRAP - 3/4" back from end of cable sheath.

NOTE: DO NOT SOLDER OR APPLY HEAT TO STRESS CONE.

- 5 INSTALL STRESS CONE

NOTE: Use large stress cone for cables with a primary insulation OD of .85 to 1.15 inches (21.6 to 29.3 mm)

Use small stress cone for cables with a primary insulation OD of .62 to .84 inches (15.7 to 21.4 mm)

Slide on stress cone and butt up against lead sheath.

NOTE: If cable is shielded or has semi-conductive tape, slide stress cone over shielding or semi-conducting tape and butt up against lead sheath.

- 6 INSTALL STRESS CONE STRAP.

(a) Position strap around stress cone and lead sheath so the arrow on the strap (see Fig. 3) is pointing toward the lead sheath.



FIG. 3

NOTE: If cable is shielded or has semi-conductive tape, the top, or front edge, of the strap must be positioned BEHIND the front edge of cable shielding or semi-conductive tape. (See Fig. 4).

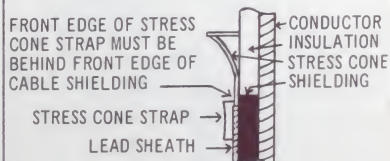


FIG. 4

(b) Pull strap tight and slip tab through appropriate slot in strap.

(c) Bend tab back on strap. Cut off excess tab and strap. (See Fig. 5).





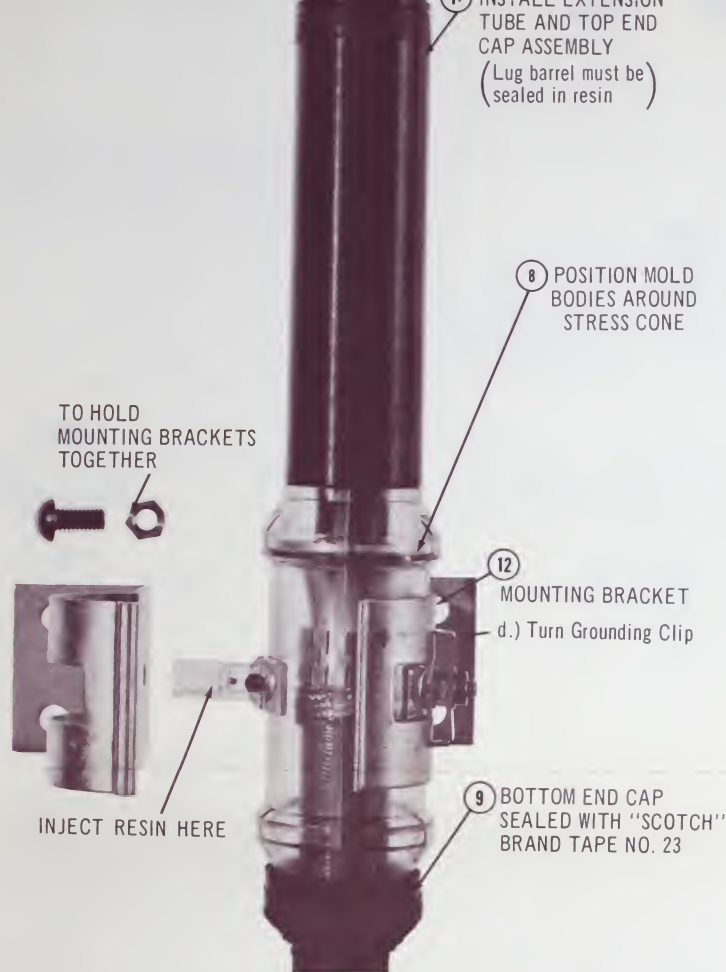


FIG. 6

- 8 POSITION MOLD BODY around stress cone and snap on the other half of mold body.

- 9 BOTTOM END CAP - "SCOTCH" BRAND TAPE No. 23

Slide bottom end cap over mold body and seal to cable with "SCOTCH" Brand Tape No. 23 supplied with kit.

NOTE: Care must be taken so stress cone does not slide out of position.

- 10 SCRAPE LUG CLEAN BEFORE INSTALLING TOP END CAP ASSEMBLY AND INJECTING RESIN.

- 11 INSTALL EXTENSION TUBE AND TOP END CAP ASSEMBLY.

Cut cable centering guides out of top end cap. Be sure that the cable is centered in the mold and end cap assembly.

CAUTION: CONNECTOR LUG BARREL MUST EXTEND INTO TOP END CAP ASSEMBLY A MINIMUM OF 1/4".

- 12 MOUNTING BRACKET.

Caution: Bracket provided is designed for direct mounting on cross arms. If termination is to be mounted on a continuous wall, additional support work shall be provided to space termination from wall in accordance with standard air

- 11 INSTALL EXTENSION TUBE AND TOP END CAP ASSEMBLY
(Lug barrel must be sealed in resin)

- 8 POSITION MOLD BODIES AROUND STRESS CONE

- 12 MOUNTING BRACKET
d.) Turn Grounding Clip

- 9 BOTTOM END CAP SEALED WITH "SCOTCH" BRAND TAPE NO. 23

(a) Drill four holes for mounting using template in the instruction manual as a guide Page 9.

(b) Fasten one half of mounting bracket, the one with the ridge, in place.

(c) Place termination in mounting bracket and install other half of bracket.

(d) Turn grounding clip so it makes contact with mounting bracket and tighten.

CAUTION: BE SURE STRESS CONE IS IN POSITION ON CABLE SHIELDING BEFORE INJECTING RESIN.

FOR MIXING RESIN, LOADING AND INJECTING PROCEDURE, SEE PAGE 9.

- 13 AFTER RESIN HAS BEEN INJECTED AND HARDENED REMOVE TRANSPARENT RESERVOIR.

INVERTED TERMINATIONS: For information regarding inverted terminations, please contact your nearest 3M sales representative or write to Minnesota Mining & Manufacturing Company, Electrical Products Division, 2501 Hudson Road, St. Paul 19, Minnesota.



1 CABLE PREPARATION DIMENSIONS

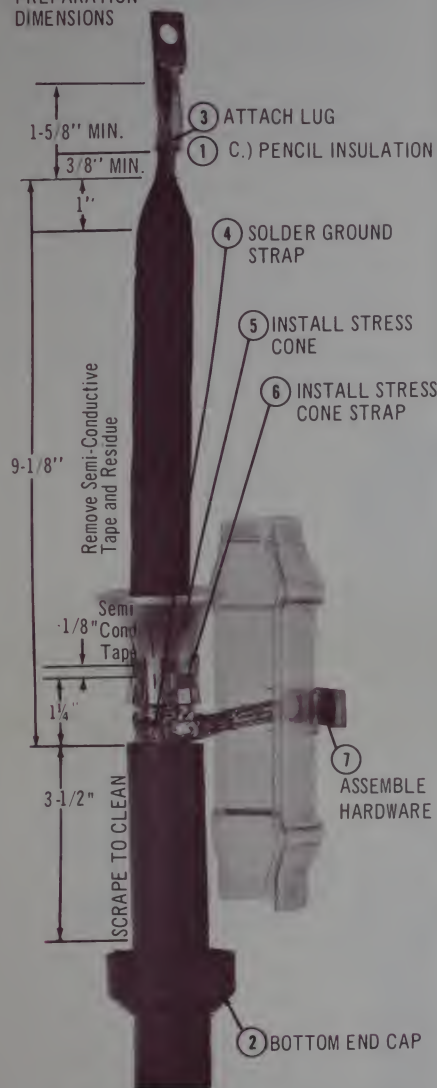


FIG. 1

FOLLOW THIS STEP-BY-STEP PROCEDURE:

- 1 CABLE PREPARATION - Use exact dimensions as shown at left of Fig. 1.

(a) Remove sheath, shielding and semi-conducting cloth to dimensions as shown. Leave 1/8\"

CAUTION: DO NOT NICK CONDUCTOR OR CUT INTO INSULATION. CUT SHIELDING SMOOTHLY. DO NOT BEND OUT EDGES. IF EDGES ARE BENT OUT, STRAIGHTEN SO THAT SHIELDING IS FLAT AND SMOOTH.

(b) Clean sheath by scraping with a knife or rasp.

CAUTION: DO NOT USE SOLVENTS. ALL THREADS AND RESIDUE FROM SEMI-CONDUCTIVE CLOTH MUST BE REMOVED. DO NOT CUT INSULATION WHEN REMOVING SHIELDING.

it must be of correct conductor type and size. The lug or pin terminal will be of the closed end type with a minimum barrel length of 1/4\"

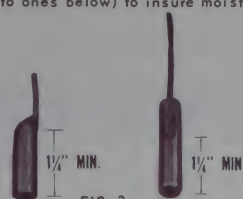


FIG. 2

If a conductor lug or terminal pin is NOT used at the dimension shown in Fig. 1, the conductor strands must be soldered completely closed for a minimum distance of 2 inches above the cable insulation.

CAUTION: CLEAN ALL DIRT AND OIL FROM CONDUCTOR.

- 4 SOLDER GROUND STRAP to shielding immediately in front of the cable sheath.

NOTE: DO NOT SOLDER OR APPLY HEAT TO STRESS CONE.

- 5 INSTALL STRESS CONE

NOTE: Use large stress cone cables with a primary insulation OD of .85 to 1.15 inches (21.6 to 29.3 mm).

Use small stress cone for cables with a primary insulation OD of .62 to .84 inches (15.9 to 21.4 mm).

Slide stress cone onto shielding for a distance of 1/4\"

- 6 INSTALL STRESS CONE STRAP

(a) Position strap around stress cone (see Fig. 3) so the arrow on the strap is pointing toward the stress cone.



FIG. 3

The top, or front edge, of the stress strap must be positioned BEHIND the front edge of cable shielding. (See Fig. 4).

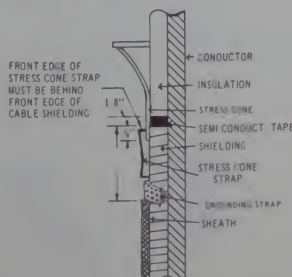


FIG. 4

- (b) Pull strap tight and slip tab through appropriate slot in strap.
- (c) Bend tab back on strap. Cut off excess tab and strap (See Fig. 5).



FIG. 5



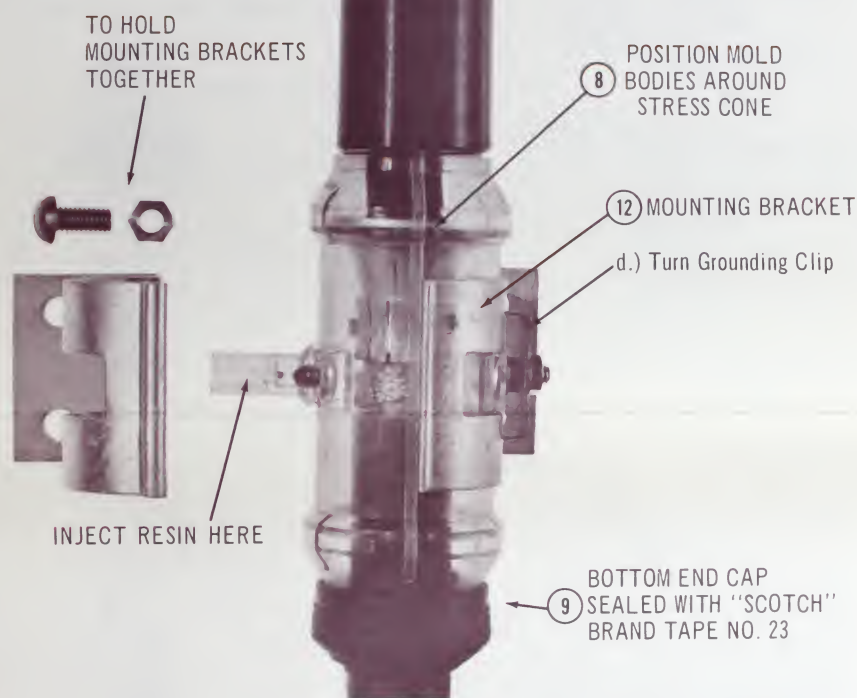


FIG. 6

- 8 POSITION MOLD BODY around stress cone and snap on the other half of mold body.

- 9 BOTTOM END CAP - "SCOTCH" BRAND TAPE No. 23.

Slide bottom end cap over mold body and seal to cable with "SCOTCH" Brand Tape No. 23, supplied with kit.

NOTE: Care must be taken so stress cone does not slide out of position.

- 10 SCRAPE LUG CLEAN BEFORE INSTALLING TOP END CAP ASSEMBLY AND INJECTING RESIN.

- 11 INSTALL EXTENSION TUBE AND TOP END CAP ASSEMBLY.

CAUTION: CONNECTOR LUG BARREL MUST EXTEND INTO TOP END CAP ASSEMBLY A MINIMUM OF 1 1/4".

- 12 MOUNTING BRACKET

Caution: Bracket provided is designed for direct mounting on cross arms. If termination is to be mounted on a continuous wall, additional support work shall be provided to space termination from wall in accordance with standard air

spacing practice for the voltage and atmospheric conditions involved.

(a) Drill four holes for mounting using template in the instruction manual as a guide Page 9.

(b) Fasten one half of mounting bracket, the one with the ridge, in place.

(c) Place termination in mounting bracket and install other half of bracket.

(d) Turn grounding clip so it makes contact with mounting bracket and tighten.

CAUTION: BE SURE STRESS CONE IS IN POSITION ON CABLE SHIELDING BEFORE INJECTING RESIN.

FOR MIXING RESIN, LOADING AND INJECTING PROCEDURE, SEE PAGE 9.

- 13 AFTER RESIN HAS BEEN INJECTED AND HARDENED CUT OFF TRANSPARENT RESERVOIR.

INVERTED TERMINATIONS: For information regarding inverted terminations, please contact your nearest 3M sales representative or write to Minnesota Mining & Manufacturing Company, Electrical Products Division, 220-5W, 2501 Hudson Road, St. Paul 19, Minnesota.



① CABLE PREPARATION DIMENSIONS

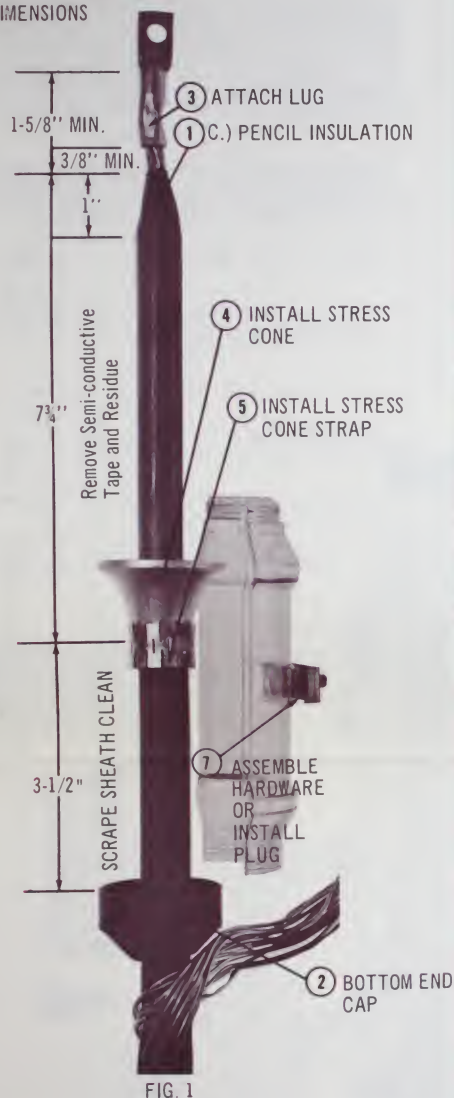


FIG. 1

FOLLOW THIS STEP-BY-STEP PROCEDURE:

- ① CABLE PREPARATION - Use exact dimensions as shown at left of Fig. 1.

(a) Remove sheath and insulation to dimensions as shown.

CAUTION: DO NOT CUT INSULATION WHEN REMOVING SHEATH.

(b) Clean sheath by scraping with a knife or rasp.

(c) PENCIL INSULATION on conductor 1 inch as shown in Fig. 1.

CAUTION: DO NOT NICK CONDUCTOR.

- ② BOTTOM END CAP

IMPORTANT: CUT HOLE IN BOTTOM END CAP SLIGHTLY LARGER THAN CABLE AND SLIDE ONTO CABLE.

- ③ ATTACH LUG



FIG. 2

If a conductor lug or terminal pin is NOT used or the dimensions shown in Fig. 1, the conductor strands must be soldered completely closed for a minimum distance of 2 inches above the cable insulation.

CAUTION: CLEAN DIRT AND OIL FROM CONDUCTOR.

- ④ INSTALL STRESS CONE

NOTE: Use large stress cone for cables with a primary insulation OD of .85 to 1.15 inches (21.6 to 29.3 mm).

Use small stress cone for cables with a primary insulation OD of .62 to .84 inches (15.9 to 21.4 mm).

Slide stress cone on cable and butt up against conductive sheath.

If a conductive tape is used, lap stress cone 1/4\"/>

- ⑤ INSTALL STRESS CONE STRAP

(a) Position strap around stress cone (see Fig. 3) so the arrow on the strap is pointing toward the stress cone.



FIG. 3

NOTE: If cable has semi-conductive tape, the top or front edge of the stress cone strap, must be positioned behind the front edge of the semi-conducting tape. See Fig. 4.

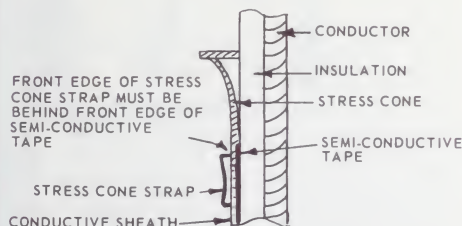


FIG. 4

(b) Pull strap tight and slip tab through appropriate slot in strap.

(c) Bend tab back on strap. Cut off excess tab and strap (see Fig. 5).



FIG. 5

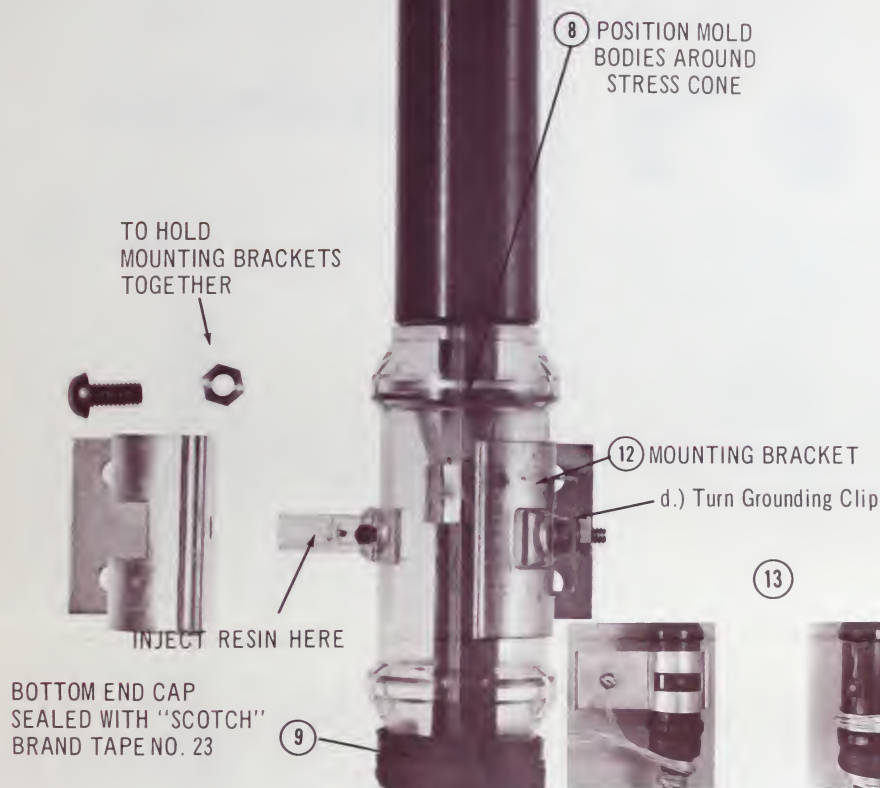
- ⑥ Remove ground strap from stud as shown below. (See alternate step below)*



FIG. 6

- ⑦ ASSEMBLE HARDWARE - Place ground strap and thread held in mold body. (Male threads





BOTTOM END CAP
SEALED WITH "SCOTCH"
BRAND TAPE NO. 23

- 8 POSITION MOLD BODY around stress cone and snap on the other half of mold body.

- 9 BOTTOM END CAP - "SCOTCH" Brand Tape No. 23.

Slide bottom end cap over mold body and seal to cable with "SCOTCH" Brand Tape No. 23 supplied with kit.

NOTE: Care must be taken so stress cone does not slide out of position.

- 10 SCRAPE LUG CLEAN BEFORE INSTALLING TOP END CAP ASSEMBLY AND INJECTING RESIN.

INSTALL EXTENSION TUBE AND TOP END CAP ASSEMBLY.

CAUTION: CONNECTOR LUG BARREL MUST EXTEND INTO TOP END CAP ASSEMBLY A MINIMUM OF 1 1/4".

- 12 MOUNTING BRACKET

Caution: Bracket provided is designed for direct mounting on cross arms. If termination is to be mounted on a continuous wall, additional support work shall be provided to space termination from wall in accordance with standard air spacing practice for the voltage and atmospheric conditions involved.

(a) Drill four holes for mounting using template

- 13 GROUNDING PROCEDURES

WHEN MOUNTING BRACKET IS USED: FIG. 8

(a) Twist External Concentric Neutral wires together around cable and up to the bottom end cap.

(b) Take Two (2) of the external concentric neutral wires and wrap around bolt holding mounting bracket together. Continue wires to grounding location.

WHEN MOUNTING BRACKET IS NOT USED: FIG. 9

(a) Twist External Concentric Neutral wires together around cable and up to the bottom end cap.

(b) Wrap concentric wires around mold body as shown in figure 9. Continue wires to grounding location.

CAUTION: BE SURE STRESS CONE IS IN POSITION BEFORE INJECTING RESIN.

FOR MIXING RESIN, LOADING AND INJECTING PROCEDURE, SEE PAGE 9.

- 14 AFTER RESIN HAS BEEN INJECTED AND HARDENED CUT OFF TRANSPARENT RESERVOIR.



① CABLE PREPARATION DIMENSIONS

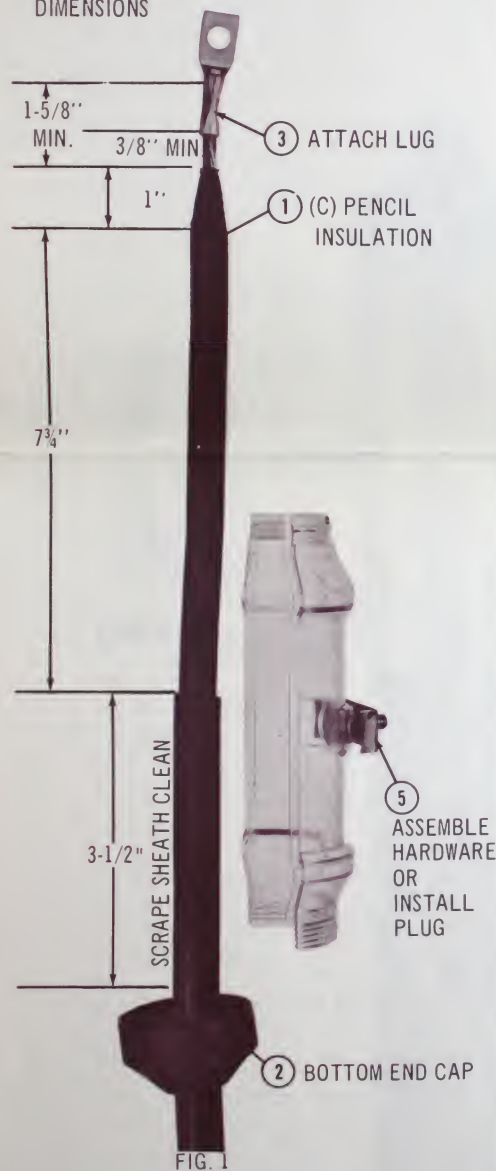


FIG. 1

FOLLOW THIS STEP-BY-STEP PROCEDURE:

① CABLE PREPARATIONS - Use exact dimensions shown at right of Fig. 1.

(a) Remove sheath and semi-conductive cloth to dimensions shown.

CAUTION: ALL CONTAMINANTS MUST BE REMOVED FROM INSULATION. DO NOT CUT INSULATION WHEN REMOVING SHEATH.

(b) Clean sheath by scraping with knife or rasp.

CAUTION: DO NOT NICK CONDUCTOR.

(c) **PENCIL INSULATION** - Remove insulation on conductor as shown in Fig. 1. Pencil insulation to prescribed length.

② BOTTOM END CAP

IMPORTANT: Cut hole in bottom end cap slightly larger than cable OD and slide onto cable.

③ ATTACH LUG

NOTE: If termination parts will not fit over connector lug, then install kit parts first and connector lug last.

Attach lug to dimensions as shown in Fig. 1. When using a conductor lug or pin terminal, it must be of correct conductor type and size. The lug or pin terminal will be of the closed end type with a minimum barrel length of $1\frac{1}{4}"$. (similar to ones below).

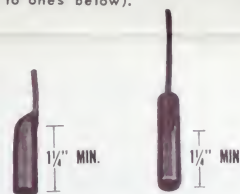


FIG. 2

NOTE: If a conductor lug or terminal pin is NOT used at the dimensions shown in Fig. 1, the conductor strands must be soldered completely closed for a minimum distance of 2 inches above the cable insulation.

NOTE: THE USE OF THE PREFORMED STRESS CONE IS NOT NEEDED FOR THIS APPLICATION.

CAUTION: CLEAN ALL DIRT AND OIL FROM CONDUCTOR.

④ REMOVE GROUND STRAP (See alternate step below.)*

Remove ground strap from lug as shown below.



FIG. 3

⑤ ASSEMBLE HARDWARE

Place stud through hole in split mold body. (Male threads of mold body toward lug end). In sequence, attach washer; nut and snug up. Attach ground clip, another washer and nut. Do not tighten at this time.

*In place of steps 4 and 5 plug the hole in Mold Body with the plastic plug supplied with the kit. Install the plug from the inside of the Mold Body so resin will not push plug out.



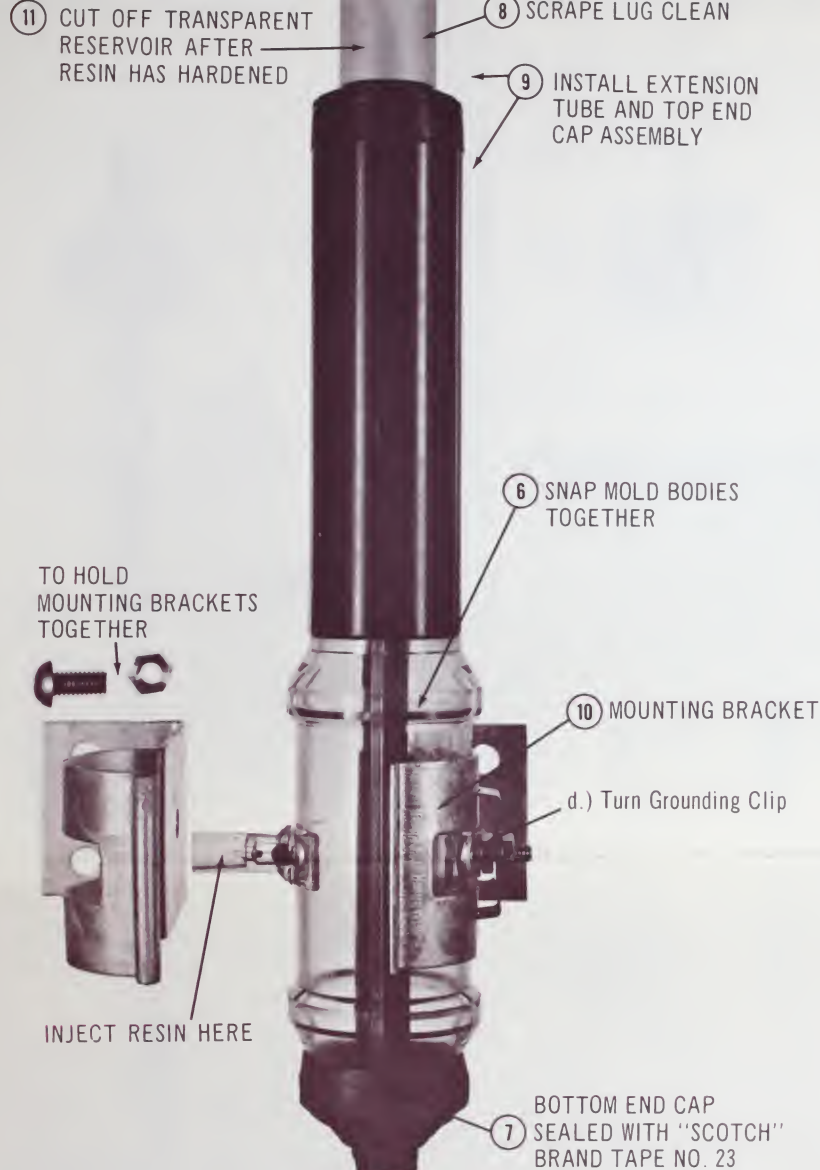


FIG. 4

6 SNAP MOLD BODIES TOGETHER

Position mold bodies on cable, (male threads toward lug end) and snap together.

7 BOTTOM END CAP - "SCOTCH" Brand Tape No. 23.

Slide bottom end cap over mold body and seal to cable with "SCOTCH" Brand No. 23 Tape supplied with kit.

8 SCRAPE LUG CLEAN BEFORE INSTALLING TOP END CAP ASSEMBLY AND INJECTING RESIN.

9 INSTALL EXTENSION TUBE AND TOP END CAP ASSEMBLY.

spacing practice for the voltage and atmospheric conditions involved.

(a) Drill four holes for mounting using Template in the instruction manual as a guide Page 9.

(b) Fasten one half of mounting bracket, the one with the ridge, in place.

(c) Place termination in mounting bracket and install other half of bracket.

(d) Turn grounding clip so that it makes contact with mounting bracket and tighten.

FOR MIXING RESIN, LOADING AND INJECTION PROCEDURE SEE PAGE 9.

13 AFTER RESIN HAS BEEN INJECTED AND HARDENED CUT OFF TRANSPARENT RESERVOIR.



package.
CAUTION: The working life of the Resin is limited. Preparation, loading, and saturation must be completed without delay.

- (2) Remove liner from a tape patch (packed with "SCOTCHCAST" Brand P-5 Nozzle.)
- (3) Place hole in tape patch over P-5 Nozzle and center the assembly near the narrow edge of the mixed "UNIPAK" container. See Figure 1.

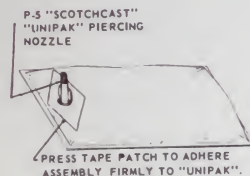


FIG. 1

b. Loading the Resin Pressure Gun

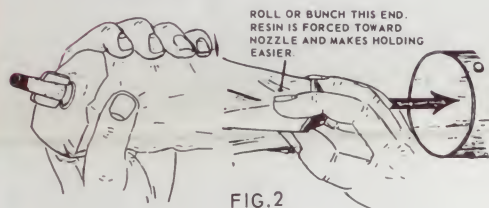


FIG. 2

- (1) Grasp the container in both hands, holding it roughly cylindrical so it can easily slide into the gun barrel. See Figure 2.
- (2) Roll or bunch the end of the container opposite the nozzle. This will force some resin toward the nozzle end and improve the cylindrical shape for loading. See Figure 2.
- (3) Slide the bag into the gun barrel. Work the handles so the nozzle tip sticks out of the barrel. Tuck in any overlapping portions of the bag.
- (4) Start the tip of the nozzle through the hole in gun cap. Lock gun cap in place. See Figure 3.



FIG. 3

- (5) Pull nozzle until fins come completely through cap. Twist clockwise to lock nozzle to cap. (Fins engage cap ramps.) Gun is now ready to use. See Figure 4.

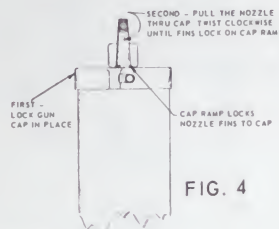


FIG. 4

c. Injecting Resin

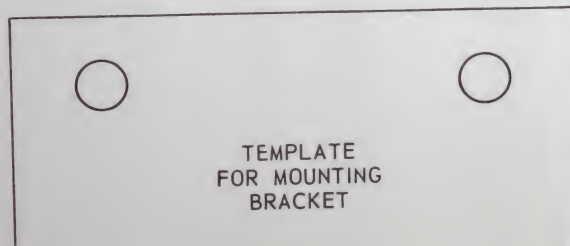
- (1) Lightly press the threaded tip of the nozzle into the Injection Fitting on the Mold Body.
- (2) Rotate entire gun 1 or 2 turns (clockwise) to engage nozzle firmly and form a liquid-tight coupling.
- (3) Work gun handles until resistance is felt. A slight extra pressure on handles will cause the cutting edges of the nozzle to pierce the container and permit resin to be pumped into the mold.
- (4) Inject resin slowly until reservoir at top of termination is full.
- (5) To remove gun, rotate entire gun counter-clockwise to unscrew nozzle from fitting.

d. General Hints on Injecting Resin.

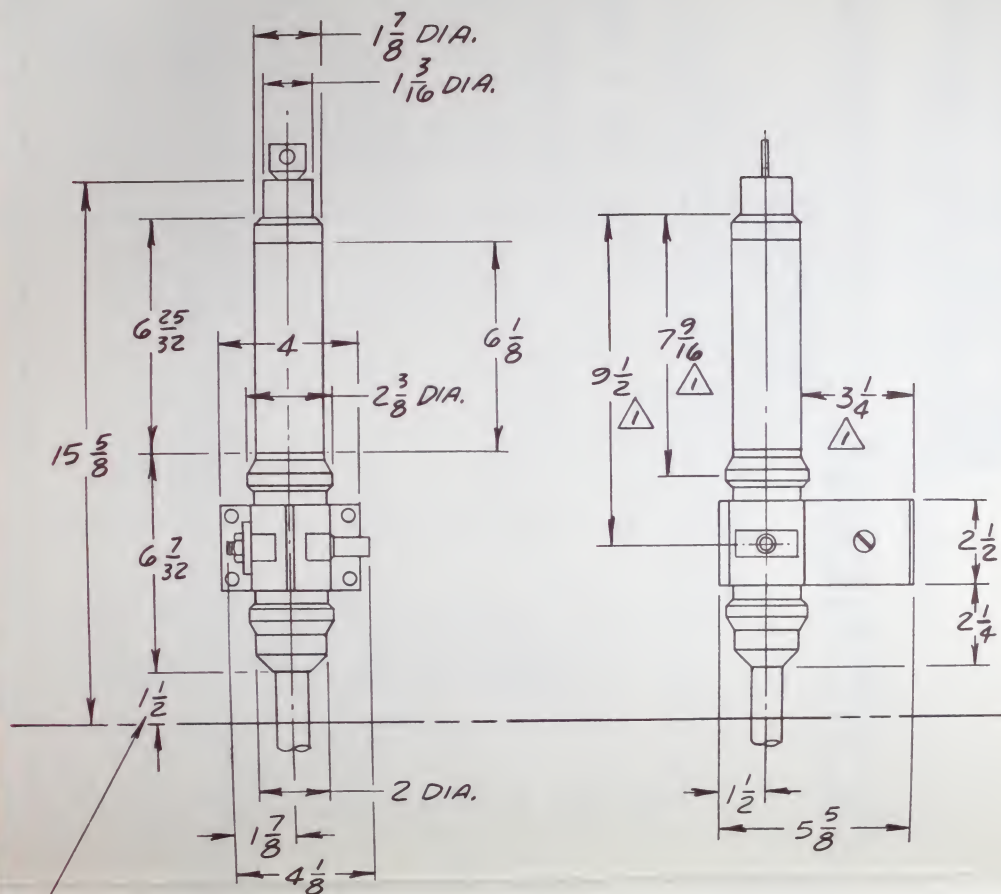
- (1) To unload gun, unlock gun cap and remove. Nozzle and container can then be unlocked from cap and discarded.
- (2) Wiping accidental drips or spills while the resin is still liquid is the easiest cleanup method.

10. LET TERMINATION STAND UNDISTURBED UNTIL RESIN IS CURED. REMOVE ANY TEMPORARY SUPPORTS. CUT OFF TRANSPARENT RESERVOIR AFTER RESIN HAS HARDENED. REMOVE SEALING TAPE FROM BOTTOM END CAP, IF DESIRED.

Note: After initial experience with these kits, splicer may wish to make up more than one termination before injecting resin.







CLEARANCE REQUIRED
FOR BOTTOM CAP



IMPORTANT INSTRUCTIONS INSIDE

INSTRUCTIONS FOR TERMINATING WITH

Scotchcast® BRAND NO. 83-B3

FOR WEATHER PROTECTED (INDOOR) OR
LOW CONDUCTIVE CONTAMINATE AREAS

TABLE OF CONTENT

FOR TERMINATING: Lead Sheathed Cables:	1
Varnished Synthetic Fiber Insulation Polyethylene Insulated Cable	1
Rubber Insulated Cable	1
Shielded Cables:	
Synthetic Sheath Rubber or Synthetic Insulations	3
External Concentric Neutral Cable with Conductive Sheath and Synthetic Insulation (URD)	5
Non-Shielded Cables: Synthetic Sheath Rubber or Synthetic Insulations	7
Loading and Injecting Resin Procedure	7
Template for Mounting Bracket	7
Termination Dimensions	7

For use on rubber, synthetic
and thermoplastic insulated cables
up to a maximum of nominal rated
voltage (phase to phase) 20K V.

Insulation diameter range:
0.62" to 1.15" (15.7 to
29.33mm)

Maximum sheath diameter:
1.7/16" (36.5mm)

NOTE: Instructions must be
followed in exact sequence to
avoid difficulty. A "SCOTCH-
CAST" Brand Resin Pressure
Gun Model E-4 is required for
resin injection.



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damage, direct or consequential, arising out of
the use of or the inability to use the product.
Before using, user shall determine the suit-
ability of the product for his intended use and
user assumes all risk and liability whatsoever
in connection therewith. The foregoing may not
be altered except by an agreement signed by
officers of seller and manufacturer.

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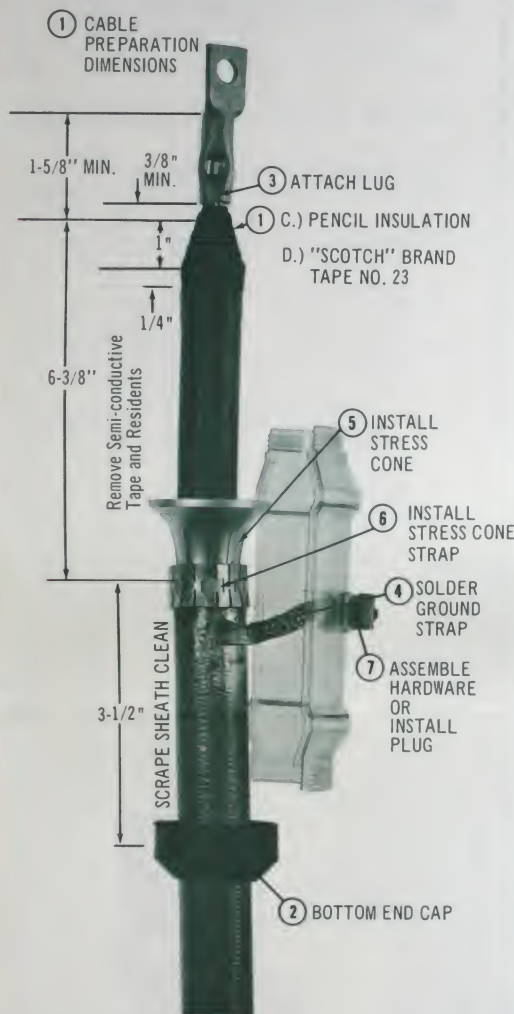


FIG. 1

FOLLOW THIS STEP-BY-STEP PROCEDURE:

- ① **CABLE PREPARATION** - Use exact dimensions as shown at left of Fig. 1

(a) Remove lead sheath to dimensions as shown.

NOTE: If cable is shielded or has semi-conductive tape, leave 1/8" of shielding or semi-conducting tape in front of lead sheath.

CAUTION: ALL THREADS AND RESIDUE FROM SEMI-CONDUCTIVE TAPE MUST BE REMOVED. DO NOT CUT INSULATION WHEN REMOVING SHEATH OR SHIELDING.

(b) **CLEAN SHEATH** by scraping with a knife or rasp. DO NOT USE SOLVENTS.

(c) **PENCIL INSULATION** on conductor 1" as shown in Fig. 1.

(d) **APPLY** one layer half-lapped of "SCOTCH" Brand Tape No. 23 (supplied with kit) over over penciled area for oil seal.

- ② **BOTTOM END CAP** - CUT HOLE IN BOTTOM

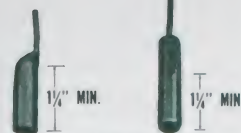


FIG. 2

NOTE: If a conductor lug or terminal pin is NOT used at the dimensions shown in Fig. 1, the conductor strands must be soldered completely closed for a minimum distance of 2 inches above the cable insulation.

CAUTION: CLEAN ALL DIRT AND OIL FROM CONDUCTOR.

- ④ **SOLDER GROUND STRAP** - 3/4" back from end of cable sheath.

NOTE: DO NOT SOLDER OR APPLY HEAT TO STRESS CONE.

- ⑤ **INSTALL STRESS CONE**

NOTE: Use large stress cone for cables with a primary insulation OD of .85 to 1.15 inches (21.6 to 29.3 mm)

Use small stress cone for cables with a primary insulation OD of .62 to .84 inches (15.7 to 21.4 mm)

Slide on stress cone and butt up against lead sheath.

NOTE: If cable is shielded or has semi-conductive tape, slide stress cone over shielding or semi-conducting tape and butt up against lead sheath.

- ⑥ **INSTALL STRESS CONE STRAP.**

(a) Position strap around stress cone and lead sheath so the arrow on the strap (see Fig. 3) is pointing toward the lead sheath.



FIG. 3

NOTE: If cable is shielded or has semi-conductive tape, the top, or front edge, of the strap must be positioned BEHIND the front edge of cable shielding or semi-conductive tape. (See Fig. 4).

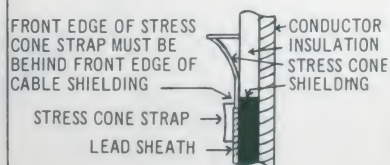


FIG. 4

(b) Pull strap tight and slip tab through appropriate slot in strap.

(c) Bend tab back on strap. Cut off excess tab and strap. (See Fig. 5).



The following is made in lieu of all warranties, express or implied:

Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his intended use and user assumes all risk and liability whatsoever in connection therewith. The foregoing may not be altered except by an agreement signed by officers of seller and manufacturer.

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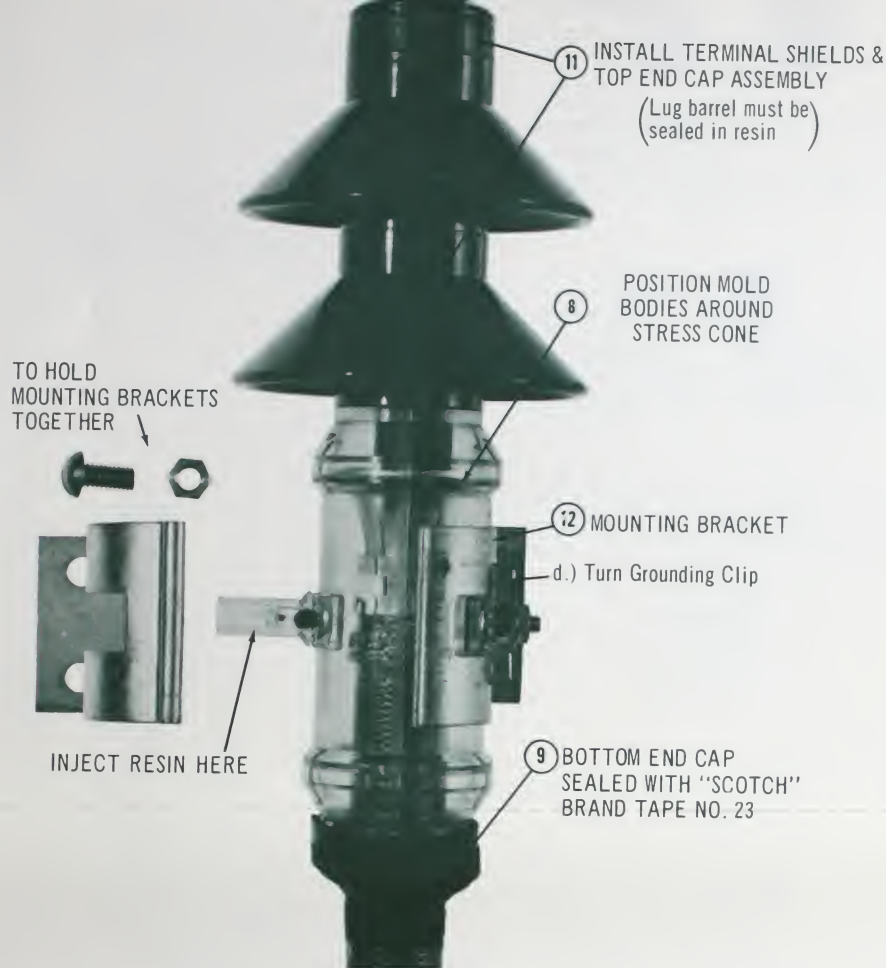


FIG. 6

- 8 POSITION MOLD BODY around stress cone and snap on the other half of mold body.

- 9 BOTTOM END CAP - "SCOTCH" BRAND TAPE No. 23

Slide bottom end cap over mold body and seal to cable with "SCOTCH" Brand Tape No. 23 supplied with kit.

NOTE: Core must be taken so stress cone does not slide out of position.

- 10 SCRAPE LUG CLEAN BEFORE INSTALLING TOP END CAP ASSEMBLY AND INJECTING RESIN.

- 11 INSTALL TERMINAL SHIELDS AND TOP END CAP ASSEMBLY.

Cut cable centering guides out of top end cap. Be sure that the cable is centered in the mold and end cap assembly.

CAUTION: CONNECTOR LUG BARREL MUST EXTEND INTO TOP END CAP ASSEMBLY A MINIMUM OF 1/4".

- 12 MOUNTING BRACKET.

Caution: Bracket provided is designed for direct mounting on cross arms. If termination is to be mounted on a continuous wall, additional sup-

(a) Drill four holes for mounting using template in the instruction manual as a guide Page 9.

(b) Fasten one half of mounting bracket, the one with the ridge, in place.

(c) Place termination in mounting bracket and install other half of bracket.

(d) Turn grounding clip so it makes contact with mounting bracket and tighten.

CAUTION: BE SURE STRESS CONE IS IN POSITION ON CABLE SHIELDING BEFORE INJECTING RESIN.

FOR MIXING RESIN, LOADING AND INJECTING PROCEDURE, SEE PAGE 9.

- 13 AFTER RESIN HAS BEEN INJECTED AND HARDENED REMOVE TRANSPARENT RESERVOIR.

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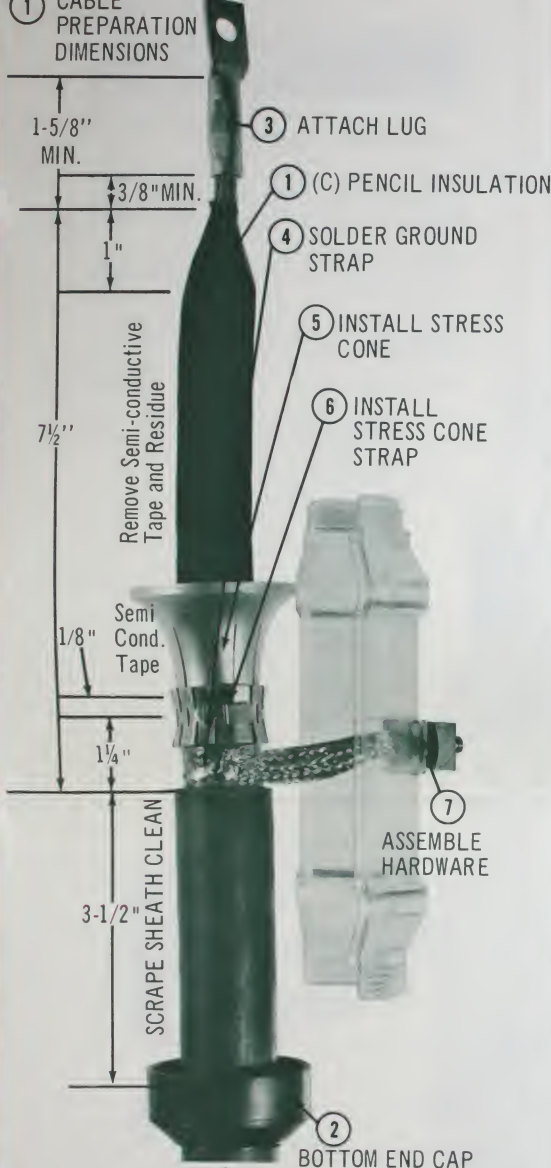


FIG. 1
FOLLOW THIS STEP-BY-STEP PROCEDURE:

- ① **CABLE PREPARATION** - Use exact dimensions as shown at left of Fig. 1.

(a) Remove sheath, shielding and semi-conducting cloth to dimensions as shown. Leave 1/8" of semi-conducting cloth above shielding.

CAUTION: DO NOT NICK CONDUCTOR OR CUT INTO INSULATION. CUT SHIELDING SMOOTHLY. DO NOT BEND OUT EDGES. IF EDGES ARE BENT OUT, STRAIGHTEN SO THAT SHIELDING IS FLAT AND SMOOTH.

(b) Clean sheath by scraping with a knife or rasp.

CAUTION: DO NOT USE SOLVENTS. ALL THREADS AND RESIDUE FROM SEMI-CONDUCTIVE CLOTH MUST BE REMOVED. DO NOT CUT INSULATION WHEN REMOVING SHIELDING.

1. When using a conductor lug or pin terminal, it must be of correct conductor type and size. The lug or pin terminal will be of the closed end type with a minimum barrel length of 1/4" (similar to ones below) to insure moisture seal.

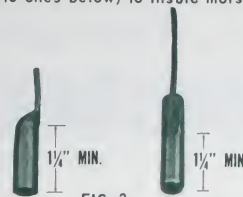


FIG. 2

If a conductor lug or terminal pin is NOT used at the dimension shown in Fig. 1, the conductor strands must be soldered completely closed for a minimum distance of 2 inches above the cable insulation.

CAUTION: CLEAN ALL DIRT AND OIL FROM CONDUCTOR.

- ④ **SOLDER GROUND STRAP** to shielding immediately in front of the cable sheath.

NOTE: DO NOT SOLDER OR APPLY HEAT TO STRESS CONE.

- ⑤ **INSTALL STRESS CONE**

NOTE: Use large stress cone cables with a primary insulation OD of .85 to 1.15 inches (21.6 to 29.3 mm).

Use small stress cone for cables with a primary insulation OD of .62 to .84 inches (15.9 to 21.4 mm).

Slide stress cone onto shielding for a distance of 1/4".

- ⑥ **INSTALL STRESS CONE STRAP**

(a) Position strap around stress cone (see Fig. 3) so the arrow on the strap is pointing toward the stress cone.



FIG. 3

The top, or front edge, of the stress strap must be positioned **BEHIND** the front edge of cable shielding. (See Fig. 4).

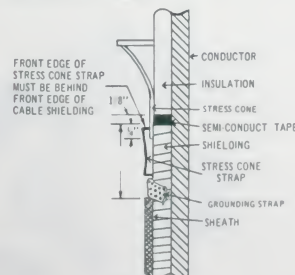


FIG. 4

(b) Pull strap tight and slip tab through appropriate slot in strap.

(c) Bend tab back on strap. Cut off excess tab and strap (See Fig. 5).



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FIG. 6

- 8 POSITION MOLD BODY around stress cone and snap on the other half of mold body.

- 9 BOTTOM END CAP - "SCOTCH" BRAND TAPE No. 23.

Slide bottom end cap over mold body and seal to cable with "SCOTCH" Brand Tape No. 23, supplied with kit.

NOTE: Core must be taken so stress cone does not slide out of position.

- 10 SCRAPE LUG CLEAN BEFORE INSTALLING TOP END CAP ASSEMBLY AND INJECTING RESIN.

- 11 INSTALL TERMINAL SHIELDS AND TOP END CAP ASSEMBLY.

CAUTION: CONNECTOR LUG BARREL MUST EXTEND INTO TOP END CAP ASSEMBLY A MINIMUM OF 1 1/4".

- 12 MOUNTING BRACKET

Caution: Bracket provided is designed for direct

spacing practice for the voltage and atmospheric conditions involved.

- (a) Drill four holes for mounting using template in the instruction manual as a guide Page 9.
(b) Fasten one half of mounting bracket, the one with the ridge, in place.
(c) Place termination in mounting bracket and install other half of bracket.
(d) Turn grounding clip so it makes contact with mounting bracket and tighten.

CAUTION: BE SURE STRESS CONE IS IN POSITION ON CABLE SHIELDING BEFORE INJECTING RESIN.

FOR MIXING RESIN, LOADING AND INJECTING PROCEDURE, SEE PAGE 9.

- 13 AFTER RESIN HAS BEEN INJECTED AND HARDENED CUT OFF TRANSPARENT RESERVOIR.

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① CABLE PREPARATION - Use exact dimensions as shown at left of Fig. 1.

- 2 BOTTOM END CAP
IMPORTANT: CUT HOLE IN BOTTOM END
CAP SLIGHTLY LARGER THAN CABLE
AND SLIDE ONTO CABLE.

- 3 ATTACH LUG

NOTE: If termination kit parts will not fit over



FIG. 2

CAUTION: CLEAN DIRT AND OIL FROM CONDUCTOR.

- If a conductive tape is used, lap stress cone 1/4" over tape and butt up against conductive sheath.

- (a) Position strap around stress cone (see Fig. 3) so the arrow on the strap is pointing toward the stress cone.



NOTE: If cable has semi-conductive tape, the top or front edge of the stress cone strap, must be positioned behind the front edge of the semi-conducting tape. See Fig. 4.

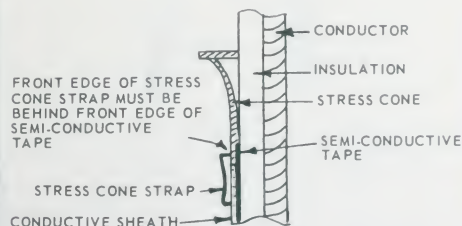


FIG. 4

- (c) Bend tab back on strap. Cut off excess tab and strap (see Fig. 5).



- 6 Remove ground strap from stud as shown below.
(See alternate step below)*



- 7 ASSEMBLE HARDWARE - Place ground strap stud through hold in mold body. (Male threads of mold body toward lug end.) In sequence,

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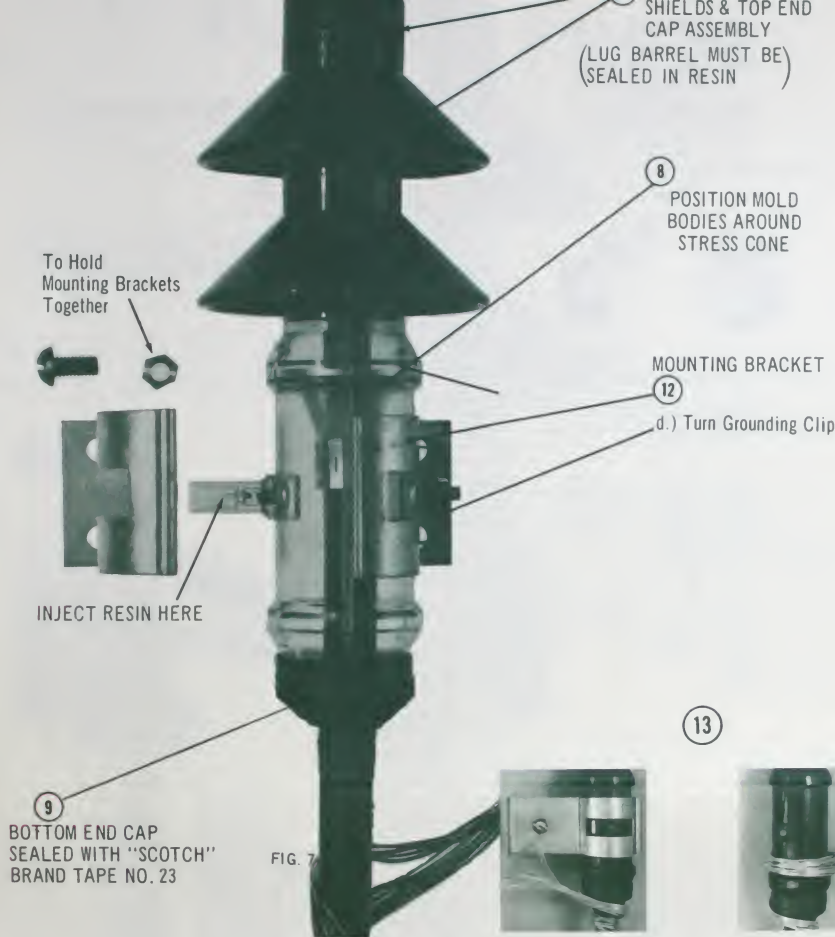


FIG. 8



FIG. 9

- 8 POSITION MOLD BODY around stress cone and snap on the other half of mold body.

- 9 BOTTOM END CAP - "SCOTCH" Brand Tape No. 23.

Slide bottom end cap over mold body and seal to cable with "SCOTCH" Brand Tape No. 23 supplied with kit.

NOTE: Care must be taken so stress cone does not slide out of position.

- 10 SCRAPE LUG CLEAN BEFORE INSTALLING TOP END CAP ASSEMBLY AND INJECTING RESIN.

INSTALL TERMINAL SHIELDS AND TOP END CAP ASSEMBLY

CAUTION: CONNECTOR LUG BARREL MUST EXTEND INTO TOP END CAP ASSEMBLY A MINIMUM OF $1\frac{1}{4}$ ".

- 12 MOUNTING BRACKET

Caution: Bracket provided is designed for direct mounting on cross arms. If termination is to be mounted on a continuous wall, additional support work shall be provided to space termination from wall in accordance with standard air spacing practice for the voltage and atmospheric conditions involved.

(a) Drill four holes for mounting using template in the instruction manual as a guide.

(b) Fasten one half of mounting bracket, the one with the ridge, in place.

- 13 GROUNDING PROCEDURES

WHEN MOUNTING BRACKET IS USED: FIG. 8

(a) Twist External Concentric Neutral wires together around cable and up to the bottom end cap.

(b) Take Two (2) of the external concentric neutral wires and wrap around bolt holding mounting bracket together. Continue wires to grounding location.

WHEN MOUNTING BRACKET IS NOT USED: FIG. 9

(a) Twist External Concentric Neutral wires together around cable and up to the bottom end cap.

(b) Wrap concentric wires around mold body as shown in figure 9. Continue wires to grounding location.

CAUTION: BE SURE STRESS CONE IS IN POSITION BEFORE INJECTING RESIN.

FOR MIXING RESIN, LOADING AND INJECTING PROCEDURE, SEE PAGE 9.

- 14 AFTER RESIN HAS BEEN INJECTED AND HARDENED CUT OFF TRANSPARENT RESERVOIR.

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- SYNTHETIC SHEATH
- RUBBER OR SYNTHETIC INSULATIONS

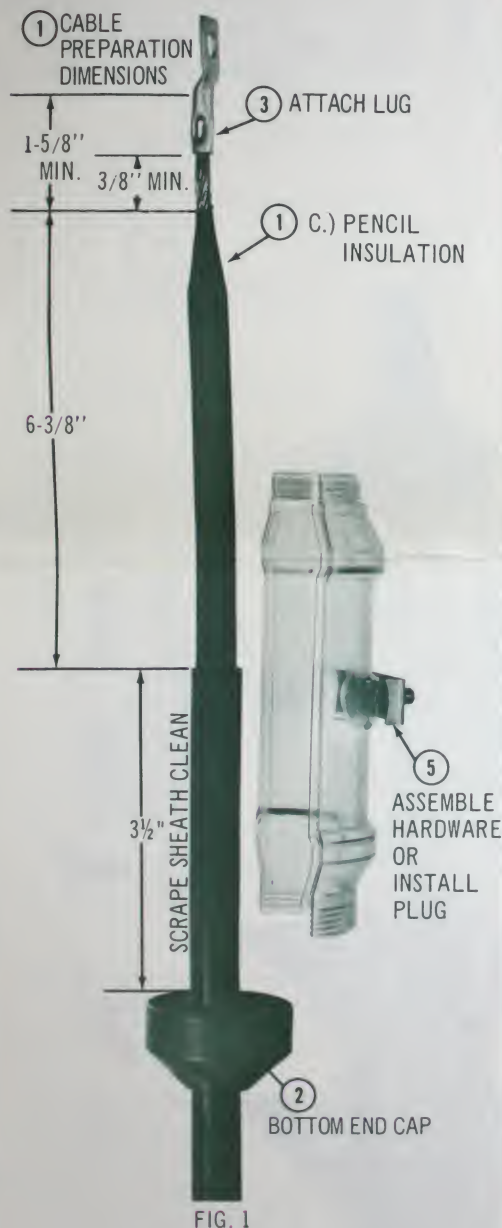


FIG. 1

FOLLOW THIS STEP-BY-STEP PROCEDURE:

- 1 CABLE PREPARATIONS - Use exact dimensions shown at right of Fig. 1.

(a) Remove sheath and semi-conductive cloth to dimensions shown.

CAUTION: ALL CONTAMINANTS MUST BE REMOVED FROM INSULATION. DO NOT CUT INSULATION WHEN REMOVING SHEATH.

(b) Clean sheath by scraping with knife or rasp.

CAUTION: DO NOT NICK CONDUCTOR.

(c) PENCIL INSULATION - Remove insulation on conductor as shown in Fig. 1. Pencil insulation to prescribed length.

- 2 BOTTOM END CAP

IMPORTANT: Cut hole in bottom end cap slightly larger than cable OD and slide onto cable.

- 3 ATTACH LUG

NOTE: If termination parts will not fit over connector lug, then install kit parts first and connector lug last.

Attach lug to dimensions as shown in Fig. 1. When using a conductor lug or pin terminal, it must be of correct conductor type and size. The lug or pin terminal will be of the closed end type with a minimum barrel length of 1/4". (similar to ones below).

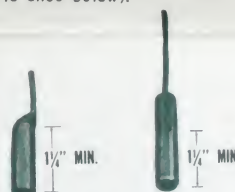


FIG. 2

NOTE: If a conductor lug or terminal pin is NOT used at the dimensions shown in Fig. 1, the conductor strands must be soldered completely clusted for a minimum distance of 2 inches above the cable insulation.

NOTE: THE USE OF THE PREFORMED STRESS CONE IS NOT NEEDED FOR THIS APPLICATION.

CAUTION: CLEAN ALL DIRT AND OIL FROM CONDUCTOR.

- 4 REMOVE GROUND STRAP (See alternate step below.)*

Remove ground strap from lug as shown below.



FIG. 3

- 5 ASSEMBLE HARDWARE

Place stud through hole in split mold body. (Male threads of mold body toward lug end). In sequence, attach washer; nut and snug up. Attach ground clip, another washer and nut. Do not tighten at this time.

*In place of steps 4 and 5 plug the hole in Mold Body with the plastic plug supplied

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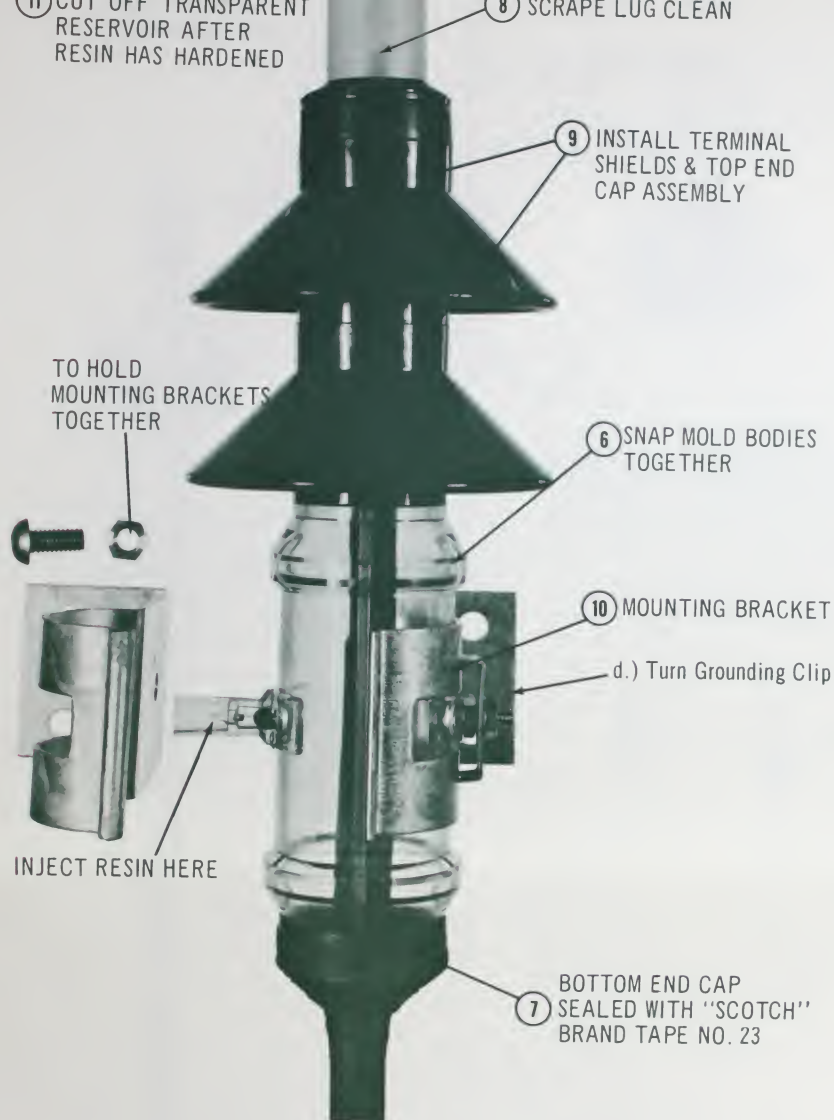


FIG. 4

6 SNAP MOLD BODIES TOGETHER

Position mold bodies on cable, (male threads toward lug end) and snap together.

7 BOTTOM END CAP - "SCOTCH" Brand Tape No. 23.

Slide bottom end cap over mold body and seal to cable with "SCOTCH" Brand No. 23 Tape supplied with kit.

8 SCRAPE LUG CLEAN BEFORE INSTALLING TOP END CAP ASSEMBLY AND INJECTING RESIN.

9 INSTALL TERMINAL SHIELDS AND TOP END CAP ASSEMBLY.

spacing practice for the voltage and atmospheric conditions involved.

(a) Drill four holes for mounting using Template in the instruction manual as a guide Page 9.

(b) Fasten one half of mounting bracket, the one with the ridge, in place.

(c) Place termination in mounting bracket and install other half of bracket.

(d) Turn grounding clip so that it makes contact with mounting bracket and tighten.

FOR MIXING RESIN, LOADING AND INJECTION PROCEDURE SEE PAGE 9.

13 AFTER RESIN HAS BEEN INJECTED AND HARDENED CUT OFF TRANSPARENT RESERVOIR.

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a. Preparation of "SCOTCHCAST" Brand Resin No. 14

- (1) Mix the contents of the "UNIPAK" Brand container per the instructions on the package.

CAUTION: The working life of the Resin is limited. Preparation, loading, and saturation must be completed without delay.

- (2) Remove liner from a tape patch (packed with "SCOTCHCAST" Brand P-5 Nozzle.)
- (3) Place hole in tape patch over P-5 Nozzle and center the assembly near the narrow edge of the mixed "UNIPAK" container. See Figure 1.

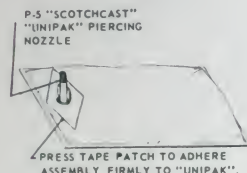


FIG. 1

b. Loading the Resin Pressure Gun

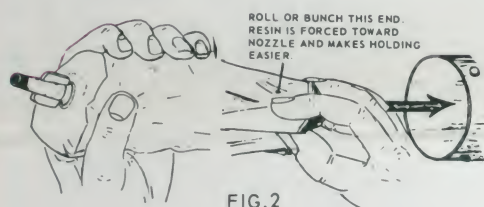


FIG. 2

- (1) Grasp the container in both hands, holding it roughly cylindrical so it can easily slide into the gun barrel. See Figure 2.
- (2) Roll or bunch the end of the container opposite the nozzle. This will force some resin toward the nozzle end and improve the cylindrical shape for loading. See Figure 2.
- (3) Slide the bag into the gun barrel. Work the handles so the nozzle tip sticks out of the barrel. Tuck in any overlapping portions of the bag.
- (4) Start the tip of the nozzle through the hole in gun cap. Lock gun cap in place. See Figure 3.



FIG. 3

- (5) Pull nozzle until fins come completely through cap. Twist clockwise to lock nozzle to cap. (Fins engage cap ramps.) Gun is now ready to use. See Figure 4.

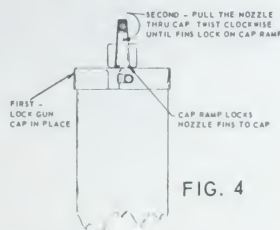


FIG. 4

c. Injecting Resin

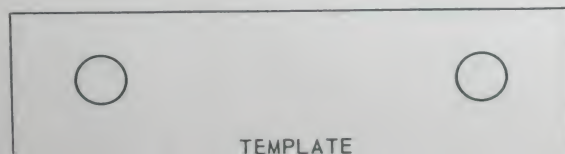
- (1) Lightly press the threaded tip of the nozzle into the Injection Fitting on the Mold Body.
- (2) Rotate entire gun 1 or 2 turns (clockwise) to engage nozzle firmly and form a liquid-tight coupling.
- (3) Work gun handles until resistance is felt. A slight extra pressure on handles will cause the cutting edges of the nozzle to pierce the container and permit resin to be pumped into the mold.
- (4) Inject resin slowly until reservoir at top of termination is full.
- (5) To remove gun, rotate entire gun counter-clockwise to unscrew nozzle from fitting.

d. General Hints on Injecting Resin.

- (1) To unload gun, unlock gun cap and remove. Nozzle and container can then be unlocked from cap and discarded.
- (2) Wiping accidental drips or spills while the resin is still liquid is the easiest cleanup method.

10. LET TERMINATION STAND UNDISTURBED UNTIL RESIN IS CURED. REMOVE ANY TEMPORARY SUPPORTS. CUT OFF TRANSPARENT RESERVOIR AFTER RESIN HAS HARDENED. REMOVE SEALING TAPE FROM BOTTOM END CAP, IF DESIRED.

Note: After initial experience with these kits, splicer may wish to make up more than one termination before injecting resin.



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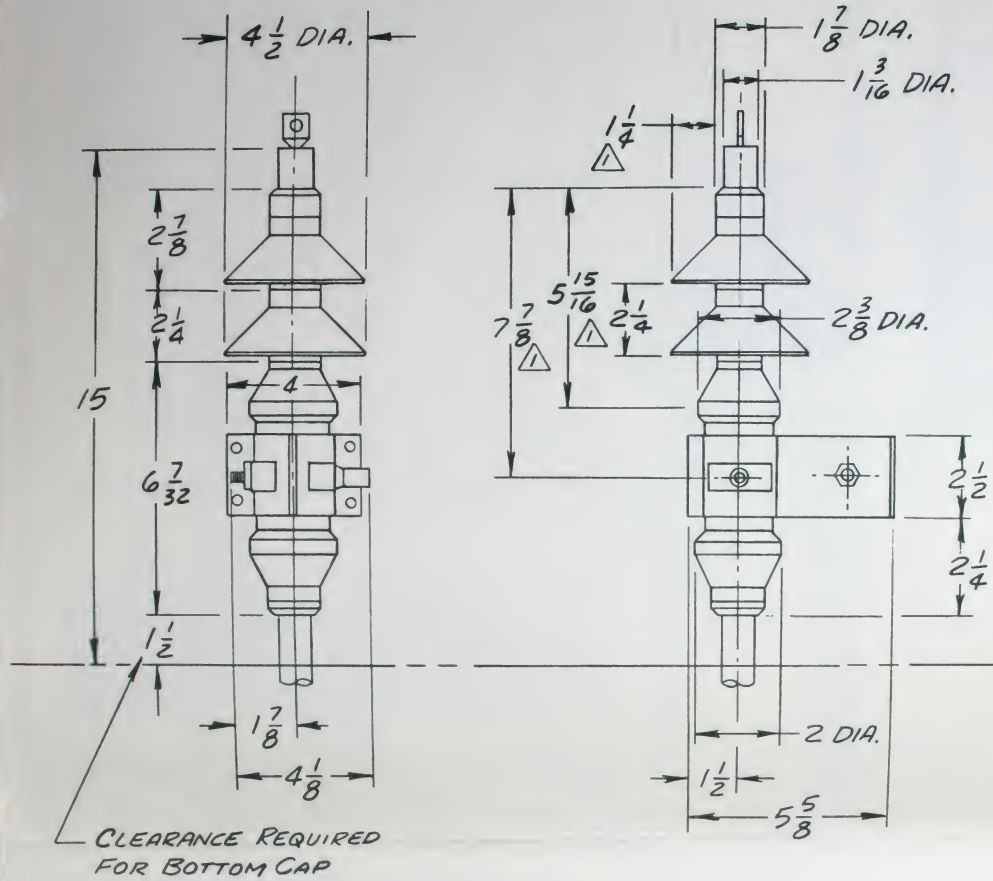
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IMPORTANT INSTRUCTIONS INSIDE

INSTRUCTIONS FOR TERMINATING WITH

Scotchcast® BRAND NO. 83-A3

FOR WEATHER EXPOSED (OUTDOOR)
LOW CONDUCTIVE CONTAMINATE AREAS

TABLE OF CONTENTS

FOR TERMINATING: Lead Sheathed Cables:	FOR WEATHER EXPOSED (OUTDOOR) LOW CONDUCTIVE CONTAMINATE AREAS
Varnished Synthetic Fiberglass Insulation Polyethylene Insulated Cable	
Rubber Insulated Cable	
Shielded Cables:	
Synthetic Sheath Rubber or Synthetic Insulations	
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Non-Shielded Cables: Synthetic Sheath Rubber or Synthetic Insulations	
Loading and Injecting Resin Procedure	
Template for Mounting Bracket	
Termination Dimensions	

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MORE HOLDING POWER

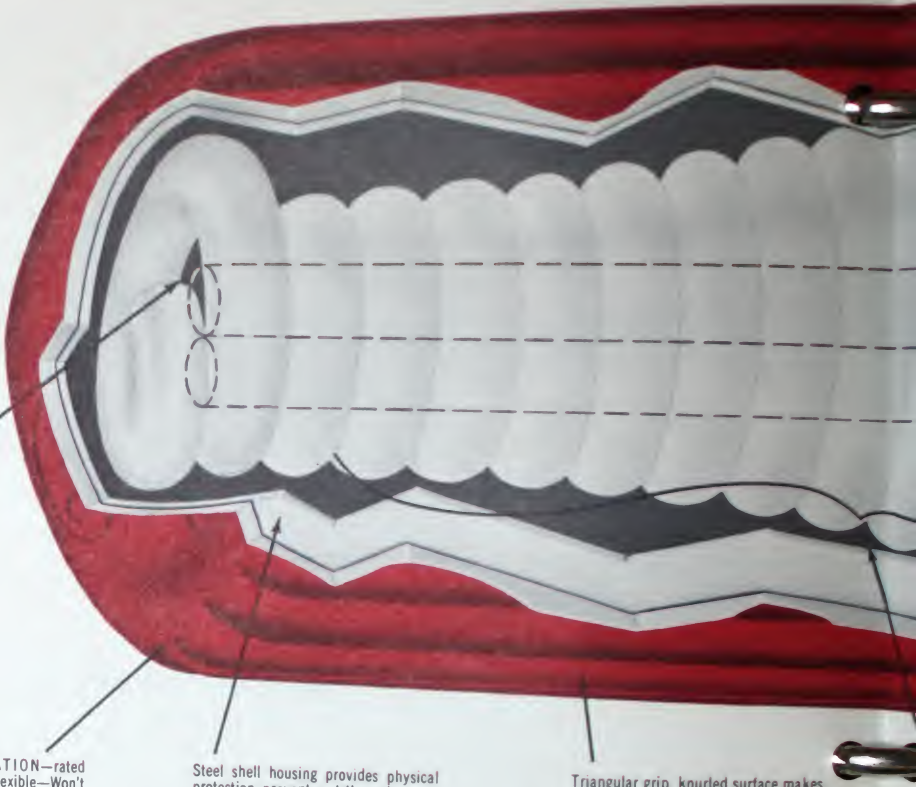


WITH NEW-IMPROVED

Scotchlok[®]
BRAND

ELECTRICAL SPRING
CONNECTORS

3M MINNESOTA MINING &
MANUFACTURING CO.



Torque controlled ratchet. Slips when conductors are fully inserted. Connector is locked on.

Easy to remove—just crimp with pliers and turn.

NEW VINYL INSULATION—rated 105° C. Unbreakable—Flexible—Won't dry out, chip or crack.

Steel shell housing provides physical protection, prevents cut-through.

Triangular grip, knurled surface makes application quick and easy.

NEW, IMPROVED
Scotchlok[®]
BRAND
CONNECTORS ARE
SCIENTIFICALLY
ENGINEERED
FOR TROUBLE-FREE
SPlice MAKING

Now form fast, easy, permanently dependable splices in seconds with "Scotchlok" Electrical Spring Connectors. ■ Your fingers are the only tools you need*—just strip wire, insert into the "Scotchlok" Connector, and twist! Instantly the shaped wire and "live-spring" action combine to grip the conductors with more than 50,000 pounds per square inch pressure. This high pressure in the contact area holds the conductors under constant tension. Establishes conductivity directly between the conductors, assuring perfect performance and trouble-free service. You get consistent, uniform connections, splice after splice after splice. ■ Every "Scotchlok" is engineered with "live spring" action. This provides a spring-compression-reserve that enables a "Scotchlok" to "bounce back" from thermal and mechanical stresses without loss of contact pressure. Stresses that often cause breakdowns in ordinary rigid-type connectors have no effect on "Scotchlok" Connectors. ■ Three color coded sizes accommodate more than 400 various wire combinations for fixtures, circuits and heavy duty systems. Extremely wide wire range (No. 6 to No. 18 AWG wire, solid and/or stranded) provides maximum versatility. Use economical "Scotchlok" Electrical Spring Connectors for all of your splicing needs.

*For "assembly line" type applications, contact your 3M salesman for free power adapter.



"Live spring" action makes application easier, grips tighter, flexes with thermal or mechanical stresses.

NEW TEARDROP SHAPED WIRE! Accommodates larger bundle of connectors. Gives up to 30% easier installation. Provides up to 20% greater holding power.

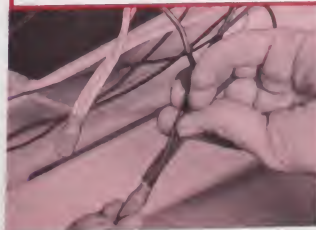
Flexible vinyl skirt makes wire insertion easier, protects conductors and prevents flashover.



TYPE B: For heavy-duty industrial applications. 6 to 12 AWG solid and stranded. UL listed as a pressure connector—rated at 75°C. for use on Cu to Cu or Al to Al wire



Type R: For general circuit connections. Wire range from No. 10 to 16 AWG—solid and stranded. UL listed as a pressure connector—rated at 105°C. for use on Cu to Cu or Al to Al wire



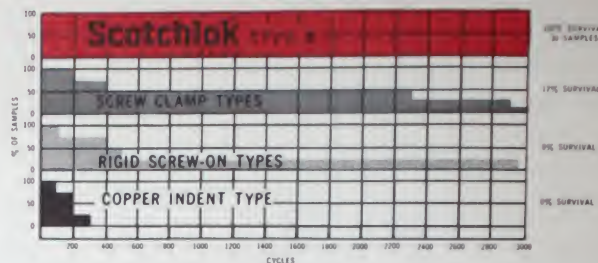
Type Y: For fixtures. Handles wire range from No. 12 to 18 AWG, solid or stranded. UL listed as a pressure and as a fixture connector—rated at 105°C.



THIS IS WHAT "LIVE SPRING" ACTION MEANS — **ELECTRICALLY!**

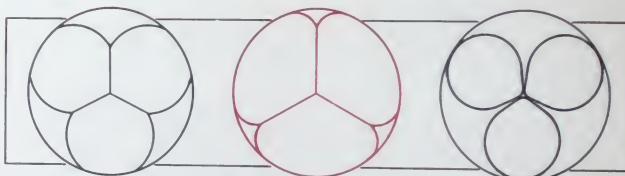
CONNECTOR CURRENT CYCLING TEST

CONDUCTOR: NO. 10 & 12 AL, NO. 12, 14 & 16S CU
SPICES: MIXED COMBINATIONS OF AL-AL & AL-CU
CURRENT: 23 AMPERES AC
CYCLE: 45 MIN. ON, 15 MIN. OFF



THIS IS WHAT "LIVE SPRING" ACTION MEANS — **PHYSICALLY!**

ORDINARY CONNECTORS

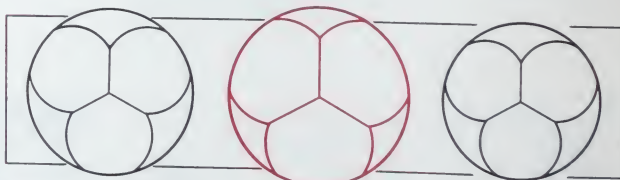


AS MADE, the connector body is rigid, non-yielding. Conductors are crushed to conform to connector dimensions.

UNDER HEAT, connector body is stretched and strained by the expanding conductors.

WHEN COLD, the cluster of conductors shrinks away from the now-stretched connector; connection pressure decreases and splice efficiency degenerates.

Scotchlok® BRAND CONNECTORS



AS MADE, the "live spring" action surrounds the conductors, assuming their shape.

UNDER HEAT, the "live spring" in the "SCOTCH-LOK" Connector gives with the conductor expansion; maintains its steady, firm grip.

WHEN COLD, the "live spring" in the "SCOTCH-LOK" Connector contracts with the shrinking conductors; keeps the splice pressure constant and maintains full splice efficiency!

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3M MINNESOTA MINING & MANUFACTURING CO.
2501 HUDSON ROAD • ST. PAUL 19, MINNESOTA

a manual
showing the
correct
application of
Scotchrap BRAND Pipe
Protection Tape



**TAPE
IT
EASY**

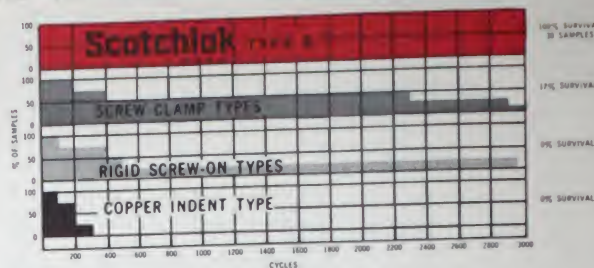


MINNESOTA MINING &
MANUFACTURING CO.

THIS IS WHAT "LIVE SPRING" ACTION MEANS — *ELECTRICALLY!*

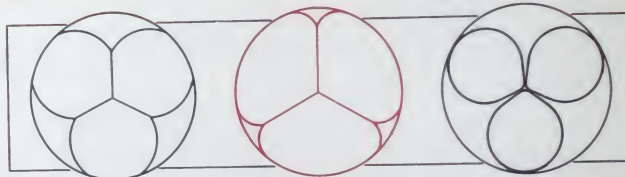
CONNECTOR CURRENT CYCLING TEST

CONDUCTOR: NO. 10 & 12 AL, NO. 12, 14 & 16S CU
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CYCLE: 45 MIN. ON, 15 MIN. OFF



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ORDINARY CONNECTORS

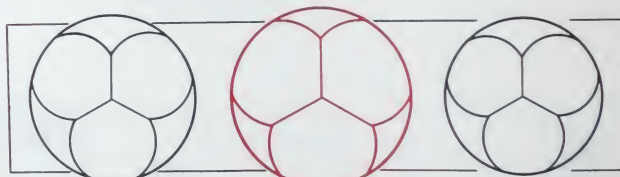


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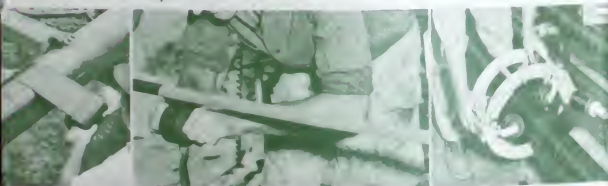
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Scotchrap® Pipe Protection Tape is easy to use. But like everything else, there are easy and hard ways to do the job. All over the country, men who are using "SCOTCHRAP" have come up with sound ideas on how to make pipe wrapping jobs better and easier. This manual is a summary of their experiences. It is printed by the 3M Company with the belief that many of our friends will find helpful suggestions on the pages which follow. Men who have had no previous experience with "SCOTCHRAP" Brand products will find this manual most helpful.

Third Edition
March, 1962



"SCOTCHRAP" Brand Pipe Protection products are available from your distributor.

"SCOTCHRAP" Brand Tape is furnished in two calipers—No. 50 (10 mil.) general purpose, No. 40 (10 mil.) all weather and No. 51 (20 mil.) heavy duty, in widths from 1" to 18".

"SCOTCHRAP" Brand Pipe Primer is packaged in gallon containers only.

"SCOTCHRAP" Brand Pipe Putty is furnished in 60 handy one-foot lengths per box.

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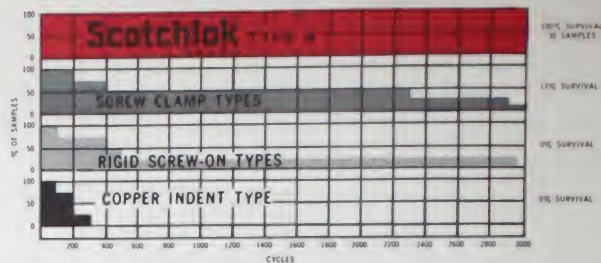
Many of the pictures in this manual were taken with the cooperation of our customers and we thank them for their help.

1

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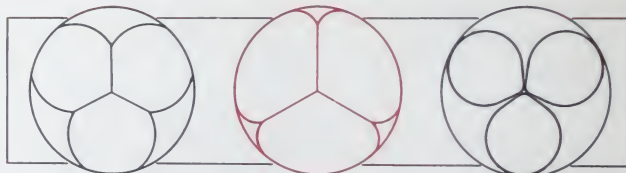
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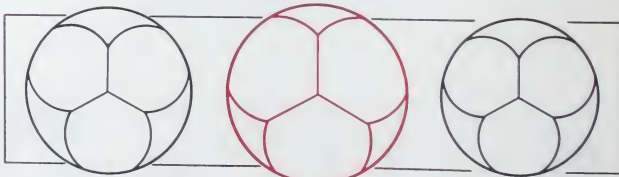


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PROTECTING WELDED JOINTS WITH

Scotchrap®
BRAND

PIPE PROTECTION TAPE

Coating welded joints, turns, tees and short sections in the field is easy and positive with "SCOTCHRAP," if you follow these simple directions:



PREPARING JOINT SURFACES

The joint area to be taped should be clean and free from sharp metal burrs.

- 1 Remove kraft paper wound over tar coating. (If paper sticks, remove it with a wood rasp or by heating it slightly with a torch. Electric paint scrapers can also be used.)
- 2 Remove or smooth sharp weld burrs with a file, axe or ballpeen hammer.
- 3 Remove excessive rust or mill scale with a wire brush.

- 4 Dust or moisture on pipe should be removed with a rag and alcohol, or other suitable solvent.



Scotchrap® BRAND PIPE PRIMER

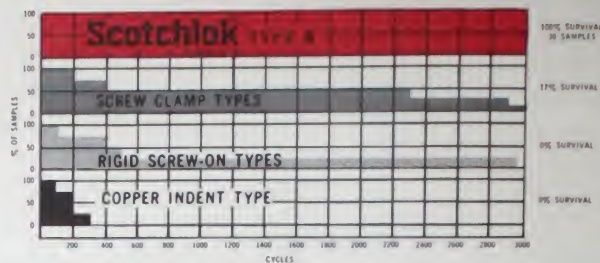
When "SCOTCHRAP" Pipe Primer is used, it will neutralize dust, condensed moisture films and superficial rust accumulated during ordinary periods of yard storage, making their removal by brush or rag unnecessary.

Apply primer by paint brush or spray coat. An average paint coat is sufficient for all but extremely rusted pipe, on which a heavier application may be needed. A uniform dark color is not necessary for adequate coating. Primer dries in a few minutes under average conditions. Apply tape any time after primer loses shine. This will take 1 to 5 minutes, depending upon humidity and temperature.

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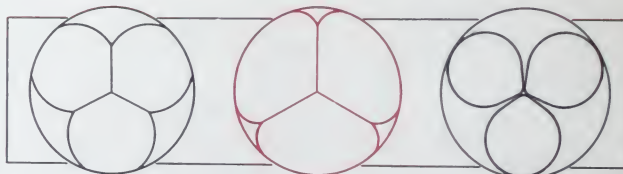
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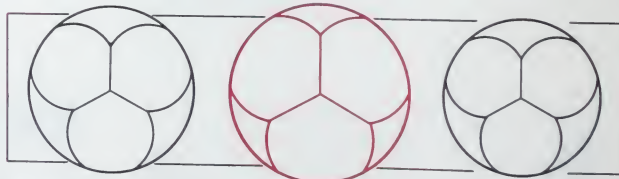


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START TAPING!

Before taping a joint, apply one wrap of tape over weld bead for extra protection (2-inch wide tape is sufficient for this purpose). At each mill wrap shoulder, apply one strip of "SCOTCHRAP" Brand Pipe Putty. This provides a smooth build-up for taping, eliminating the need to taper the mill shoulder. Begin the main application with one complete wrap of tape starting

3 inches on shoulder of mill coating.

In taping pipe, it is usually easier for one man to straddle the pipe and tape alone if the pipe is 8 inches or less in diameter. Two men can usually do a better and faster job on a large pipe by using a short length of $\frac{3}{4}$ inch pipe or a stick as a handle. Tape should be applied according to the engineer's specifications.



FINISH TAPING

Finish taping by making one complete wrap over the opposite shoulder of mill coating with 3 inches of tape on the coating shoulder.

PATCHING

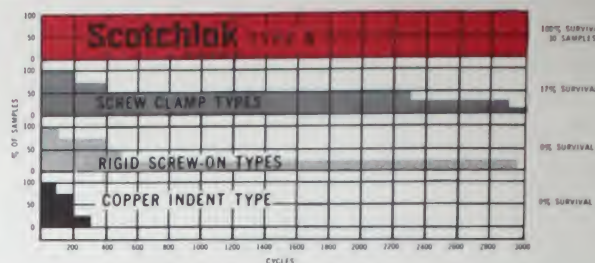
"SCOTCHRAP" makes a quick, positive patch for damaged sections of mill coating. If damaged area is deep, pipe putty can be used to level to mill wrapped surface before applying tape.



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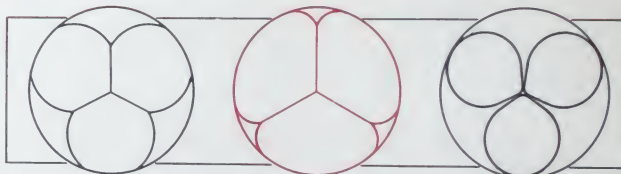
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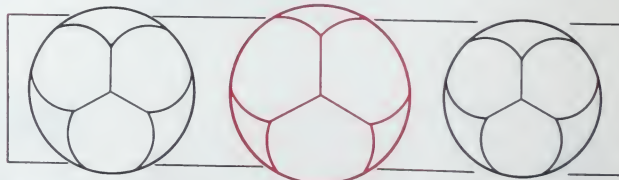


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BENDS, ELBOWS, SHORT SECTIONS

All-weather "SCOTCHRAP" Brand Pipe Protection Tape No. 40 can be applied under freezing conditions. It will conform to irregular shapes and fittings. Wound on after pipe bends are made, it eliminates the problem of chipped and cracked coatings caused by pipe bending.

SUMMARY OF HELPFUL SUGGESTIONS FOR APPLICATION

- Smooth burrs on weld bead before taping.
- Remove loose mill coating from shoulders or damaged areas.
- Apply pipe putty to all shoulders and irregular surfaces.
- Stretch tape evenly during application and only enough to make it conform smoothly.
- Don't wrap tape over water-absorbing kraft paper.



Completed joint. Any "SCOTCHRAP" - protected joint may be jeoped as a continuous operation when it is used with heavier coatings. If high voltage is used due to the thickness of tar or asphalt, a layer of felt over "SCOTCHRAP" will give added thickness and allow jeeping at 14,000 or even 16,000 volts.

TAPING STRAIGHT PIPE

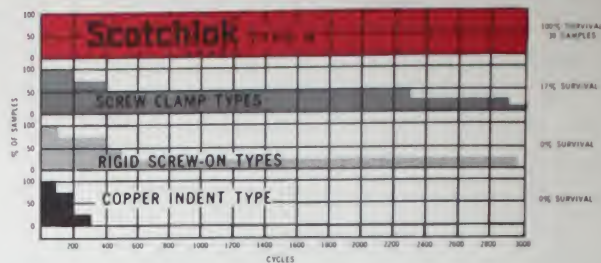
Large diameter pipe is usually taped after bending, positioning and welding. This procedure eliminates damage to the coating, particularly in rough terrain.



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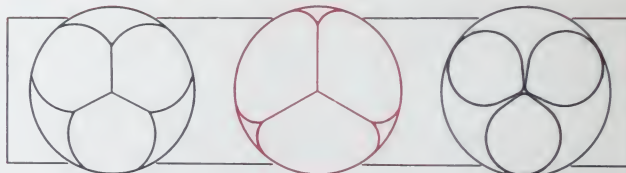
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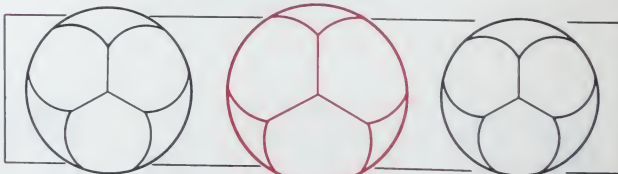


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On pipe 12 inches in diameter, and larger, two men can usually wrap faster than one.

Pipe may be taped before or after assembly using a taping machine. When lifting pipe which has been taped, use a pad of rock shield or other suitable material as protection under the sling. A wire or chain sling is better than cloth, because a cloth sling tends to stretch and pull the tape.



A dolly running on pipe ahead of the machine eliminates the necessity of using a sling on a taped surface.

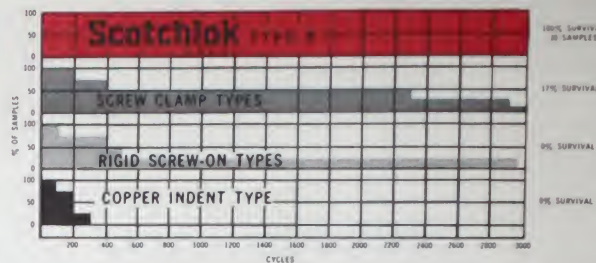


This pipe was assembled in a large excavated area. It was taped in place as the last operation before back-filling.

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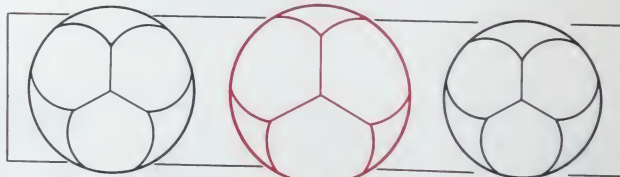


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Small pipe can be taped in place before or after assembly.

TAPING TYPICAL FITTINGS

A new system of protecting hard-to-wrap fittings has been developed, using "SCOTCH-RAP" Brand Pipe Protection Tape. Most fittings wrap best with 2 inch and 1 inch tape, although the principle can be

expanded to larger fittings using wider tape. The pictures that follow illustrate the correct method of wrapping common fittings quickly and positively.

TAPING TEES

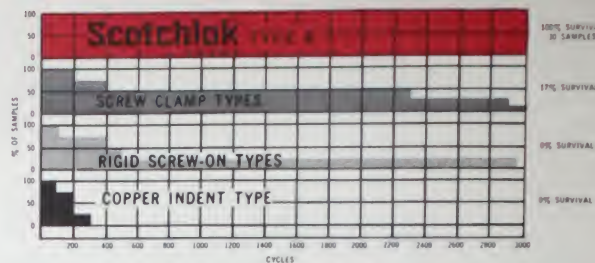
Apply pipe putty to shoulders and irregular surfaces. If main is mill coated, fill void at base of tee with putty.



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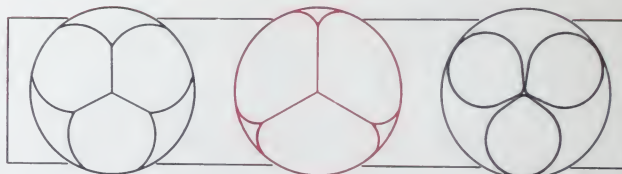
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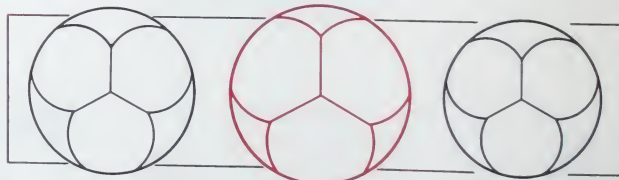


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Apply 2-inch tape over compression nut — around tee saddle — around tee elbow junction. Use enough tension on these and succeeding wraps to get conformable, wrinkle-free surface. Place strips of tape over putty on the main at the base of the tee.



Bring tape around main and over putty on one side of tee, around main and over putty on other side of tee, and around main to back of tee. About 4 inches of tape should be left above tee base.



Unroll 2-inch tape and split end in half for length of about 4 inches, (depending upon tee size). Place end of split at base of tee and wrap flaps around tee base.



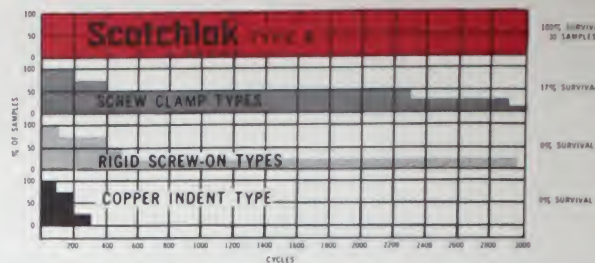
The 4-inch end should be split and the flaps wrapped around the base of the tee.

(The taping of the main can be done now or after the tee is completed.)

THIS IS WHAT "LIVE SPRING" ACTION MEANS — *ELECTRICALLY!*

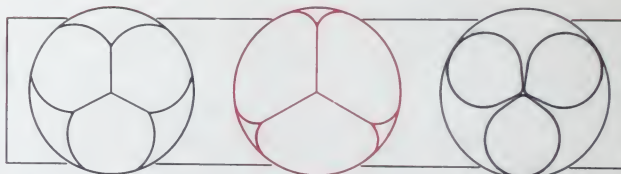
CONNECTOR CURRENT CYCLING TEST

CONDUCTOR: NO. 10 & 12 AL, NO. 12, 14 & 16S CU
SPICES: MIXED COMBINATIONS OF AL-AL & AL-CU
CURRENT: 23 AMPERES AC
CYCLE: 45 MIN. ON, 15 MIN. OFF



THIS IS WHAT "LIVE SPRING" ACTION MEANS — *PHYSICALLY!*

ORDINARY CONNECTORS

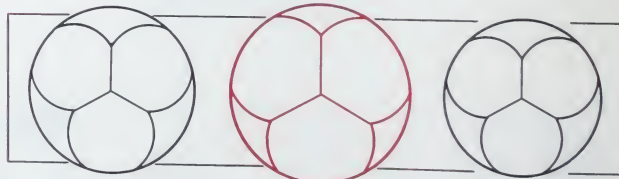


AS MADE, the connector body is rigid, non-yielding. Conductors are crushed to conform to connector dimensions.

UNDER HEAT, connector body is stretched and strained by the expanding conductors.

WHEN COLD, the cluster of conductors shrinks away from the now-stretched connector; connection pressure decreases and splice efficiency degenerates.

Scotchlok[®] BRAND CONNECTORS



AS MADE, the "live spring" action surrounds the conductors, assuming their shape.

UNDER HEAT, the "live spring" in the "SCOTCH-LOK" Connector gives with the conductor expansion; maintains its steady, firm grip.

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TAPING A PLUG

To tape plug, center a 6-inch piece of 2-inch tape over top and snug down.

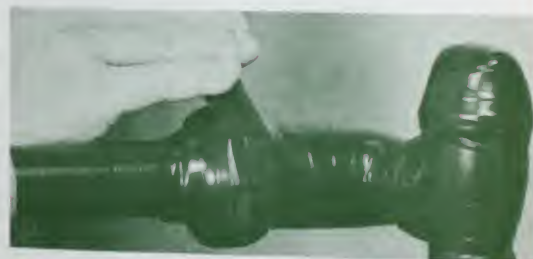


Swing around tee and wrap along the elbow to top of compression nut.



Using 1-inch tape, start at base of tee, wrap up the stem and "X" over the tee saddle. Continue wrap over the plug and back to the saddle.

See page 19 for completion of tee.

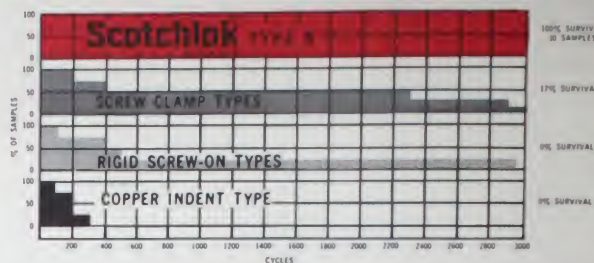


Using 1-inch tape, start on the service and wrap to the compression nut. End tape on flat surface of the nut. This completes tee.

THIS IS WHAT **"LIVE SPRING"** ACTION MEANS — **ELECTRICALLY!**

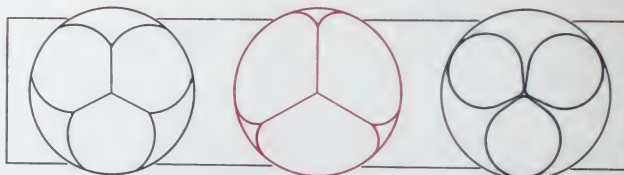
CONNECTOR CURRENT CYCLING TEST

CONDUCTOR: NO. 10 & 12 AL, NO. 14 & 16S CU
SPICES: MIXED COMBINATIONS OF AL-AL & AL-CU
CURRENT: 23 AMPERES AC
CYCLE: 45 MIN. ON, 15 MIN. OFF



THIS IS WHAT **"LIVE SPRING"** ACTION MEANS — **PHYSICALLY!**

ORDINARY CONNECTORS

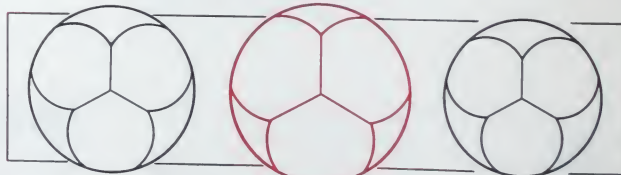


AS MADE, the connector body is rigid, non-yielding. Conductors are crushed to conform to connector dimensions.

UNDER HEAT, connector body is stretched and strained by the expanding conductors.

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TAPING COUPLINGS

METHOD I Apply pipe putty to shoulders as shown to provide smooth taper.



Apply 2-inch tape to each side of each coupling nut, to cover nuts and pipe putty. Use sufficient stretch to get smooth, wrinkle-free surface.



Using 1-inch tape, start on service on each side of coupling and wrap to the center of the coupling barrel for complete coverage.

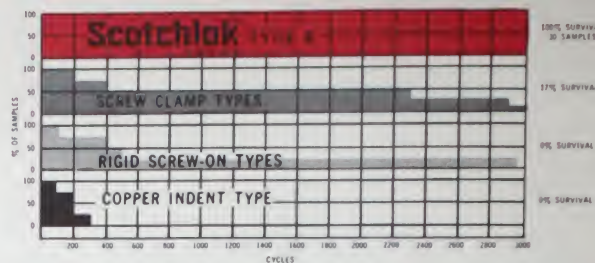


Complete job.

THIS IS WHAT "LIVE SPRING" ACTION MEANS — *ELECTRICALLY!*

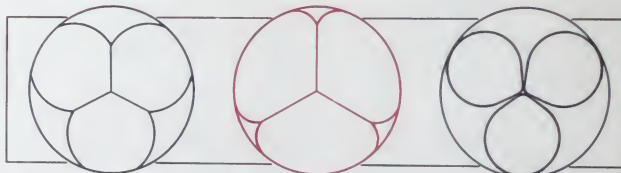
CONNECTOR CURRENT CYCLING TEST

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SPICES: MIXED COMBINATIONS OF AL-AL & AL-CU
CURRENT: 23 AMPERES AC
CYCLE: 45 MIN. ON, 15 MIN. OFF



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ORDINARY CONNECTORS

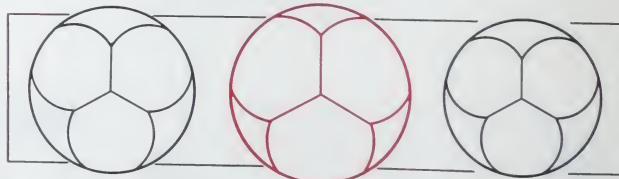


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METHOD II

Apply pipe putty to service about $1\frac{1}{2}$ inches from coupling nuts. Center edges of wide width of tape in the putty. Width of tape is governed by coupling size.



Using 1-inch tape, tie down ends of wide tape. Wrap down service on each side of coupling. Apply tension to tape when wrapping over putty to cause it to flow and complete seal.



Join tape adhesive-to-adhesive and fold down. Press tape edges into putty, push putty up and over tape edge to form seal. Use additional putty if needed.

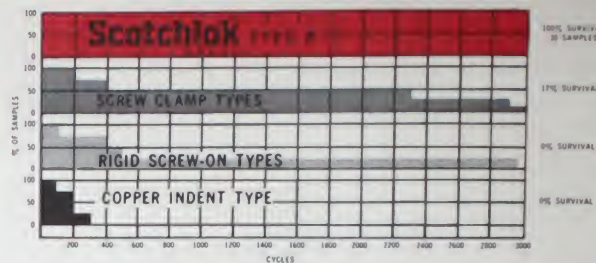
Completed cigarette wrapped coupling.



THIS IS WHAT "LIVE SPRING" ACTION MEANS — *ELECTRICALLY!*

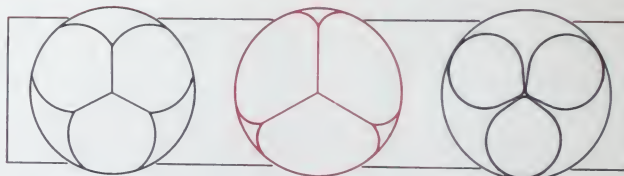
CONNECTOR CURRENT CYCLING TEST

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CYCLE: 45 MIN. ON, 15 MIN. OFF



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ORDINARY CONNECTORS

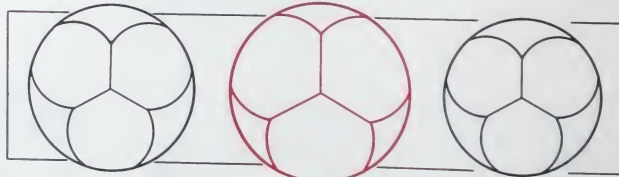


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PIPE COVERAGE TABLE

Pipe Size In Inches		Recom- mended Tape Width	Minimum Tape Overlap	Squares of Tape Needed Per 100 Lineal Feet of Pipe	Squares of Tape Needed Per 100 Lineal Feet of Pipe	Number of Squares Feet Per 100 Lineal Feet of Pipe
ID	OD			Minimum Overlap	Half-Lapped	
1/2"	.84"	1"	1/2"	.293	.44	22.0
3/4"	1.05"	1"	1/2"	.367		
		2"	3/4"	.339	.55	27.5
1"	1.32"	1"	1/2"	.461	.692	34.6
		2"	3/4"	.426		
		4"	1"	.395		
1 1/4"	1.66"	2"	3/4"	.535	.870	43.5
		4"	1"	.497		
1 1/2"	1.90"	2"	3/4"	.612	.994	49.7
		4"	1"	.569		
2"	2.38"	2"	3/4"	.767	1.246	62.3
		4"	1"	.713		
2 1/2"	2.88"	2"	3/4"	.928	1.508	75.4
		4"	1"	.862		
3"	3.50"	2"	3/4"	1.127	1.832	91.6
		4"	1"	1.047		
3 1/2"	4.00"	2"	3/4"	1.289	2.094	104.7
		4"	1"	1.197		
4"	4.50"	2"	3/4"	1.450	2.356	117.8
		4"	1"	1.346		
4 1/2"	5.00"	2"	3/4"	1.496	2.618	130.9
		4"	1"	1.667	2.916	145.8
5"	5.57"	2"	3/4"	1.984	3.472	173.6
		4"	1"	1.894		
6"	6.63"	2"	3/4"	2.282	3.994	199.7
		4"	1"	2.178		
7"	7.63"	2"	3/4"	2.582	4.518	255.9
		4"	1"	2.464		
8"	8.63"	2"	3/4"	3.070	5.628	281.4
		4"	1"	3.002		
10"	10.75"	2"	3/4"	3.356	6.152	307.6
		4"	1"	3.281		
11"	11.75"	2"	3/4"	3.641	6.676	333.8
		4"	1"	3.561		
12"	12.75"	2"	3/4"	3.998	7.330	366.5
		4"	1"	3.909		
14"		2"	3/4"	4.570	8.378	418.9
		4"	1"	4.468		
16"		2"	3/4"	5.141	9.426	471.3
		4"	1"	5.027		
18"		2"	3/4"	5.712	10.472	523.6
		4"	1"	5.585		
20"		2"	3/4"	6.283	11.520	576.0
		4"	1"	6.144		
22"		2"	3/4"	6.817	12.498	624.9
		4"	1"	6.667		
24"		2"	3/4"	7.426	13.614	680.7
		4"	1"	7.261		
26"		2"	3/4"	8.568	15.708	785.4
		4"	1"	8.378		
30"		2"	3/4"	9.710	17.802	890.1
		4"	1"	9.494		
34"		2"	3/4"	9.288		
		4"	1"	10.281	18.850	942.5
		8"	1"	10.053		
36"		2"	3/4"	9.835		
		4"	1"			

24

"SCOTCHRAPI" BRAND PIPE PRIMER - 1 Gallon Will Cover From 500 to 700 Square Feet Depending on the Surface Condition of the Pipe.

While the chart on page 24 gives pipe coverage data for most common sizes, the following formula may be helpful for nonstandard items:

$$\text{Squares of Tape} = \frac{\pi (LP) (DP) TW}{1200 (TW-OV)}$$

$\pi = 3.1416$ LP = Length of Pipe (Ft.)

DP = Outside Diameter of Pipe (In.)

TW = Tape Width (In.) OV = Overlap of Tape (In.)

3M BRANCH OFFICES

ATLANTA
5925 Peachtree Industrial Blvd.,
Chamblee, Ga.
BOSTON, 155 Fourth Ave.,
Needham Heights 94, Mass.
BUFFALO 6, NEW YORK
330 Green St.
(Mail: P.O. Box 2012, Zone 5)
CHICAGO, ILLINOIS
6850 South Harlem Ave. (Argo P.O.)
Bedford Park, Illinois
CINCINNATI 37, OHIO
4835 Para Drive
CLEVELAND 30, OHIO
12200 Brookpark Road
DALLAS 28, TEXAS
2121 Santa Anna Ave.
DETROIT 13, MICHIGAN
411 Piquette
GRAND RAPIDS 4, MICHIGAN
815 Monroe Avenue
HIGH POINT 3, NORTH CAROLINA
2401 Brevard St.
LOS ANGELES 22, CALIFORNIA
6023 S. Garfield Ave.
NEW YORK, 700 Grand Ave.
Ridgefield, New Jersey
PHILADELPHIA 20, PENNA.
5698 Rising Sun Ave.
ST. LOUIS 32, MISSOURI
10725 Baur Blvd.
ST. PAUL 1, MINN., 935 BUSH AVE.
SO. SAN FRANCISCO, CALIF.
320 Shaw Road
SEATTLE 4, WASHINGTON
3663 First Ave. So.



CORROSION PROTECTION PRODUCTS BRAND



3M MINNESOTA MINING & MANUFACTURING CO.



"SCOTCHRAP" Brand Pipe Protection Tapes provide compatible protection for joints and fittings on pipe coated with "SCOTCHKOTE" Brand Protective Resin No. 101. "SCOTCHKOTE" No. 101 is a hydrazide-epoxy resin coating specifically designed for corrosion prevention. It has been proven by utilities and other customer field tests to be a practical corrosion protective coating. Because of its excellent impact and abrasion resistance, No. 101 coated pipe requires minimum handling precautions and can be shipped and stored without special padding or separators. It can also be driven under roads

without fear of stripping the coating. "SCOTCHKOTE" No. 101 has excellent chemical resistance which makes it suitable for use in chemical plants, refineries, etc., where chemical corrosion is prevalent.

Another economy possible with "SCOTCHKOTE" No. 101 coated pipe is the low current requirements when supplemental protection is used. Mill-coated pipe, electrically inspected and holiday free is now available: contact our branch sales office nearest you or write direct for further information.

WHAT ARE "SCOTCHRAP" PIPE PROTECTION TAPES?	Page 3
COATING REQUIREMENTS	Page 4-6
APPLICATION OF "SCOTCHRAP" TAPES	Page 7-10
COVERAGE TABLES	Page 10
PHYSICAL/ELECTRICAL PROPERTIES OF "SCOTCHRAP" TAPES	Page 11
"SCOTCHRAP" BRAND PIPE PRIMER	Page 11
"SCOTCHRAP" BRAND PIPE INSULATION PUTTY	Page 11
HOW TO ORDER	Page 12

WHAT ARE **Scotchrap** PIPE PROTECTION TAPES?

"SCOTCHRAP" Brand Pipe Protection Tapes are made with a vinyl (polyvinyl chloride) backing and a firm, hi-tack adhesive. Vinyl is a highly versatile, tough and stable plastic. With proper compounding, it is possible to obtain a wide range of properties such as stretchiness, toughness, conformance, chemical resistance, etc. "SCOTCHRAP" Vinyl Pipe Protection Tapes are tailor-made to do one job—prevent corrosion. The firm, tacky adhesive is designed to stick well and hold the backing in place, unaffected by pipe or soil movement.

"SCOTCHRAP" Tapes require no special application techniques or equipment to apply—just wrap them on to obtain a "factory-controlled" uniform coating quickly and easily. Supplied in handy pressure-sensitive roll form, they are ready for instant use. No special solvent, equipment, or heat is needed.

Tough and built to take it, "SCOTCHRAP" Tapes resist abrasion, rock penetration and soil stresses, and will not shrink or stress crack on exposure. They resist the attack of soil acids, alkalies, salts and most petroleum products, commercial chemicals and chemical vapors. Raw materials have been carefully chosen to make the tapes funginert.

"SCOTCHRAP" Tapes are economical, for example: the "finished job" costs for many applications have been below the cost per year of plant maintenance painting. "SCOTCHRAP" Tapes provide a high quality, long lasting protective coating that can be applied easily and economically even by a semi-skilled workman. Factory controlled properties mean no thin spots or runoff to leave unprotected areas, thus eliminating the uncertainty of coating continuity. You always receive the same dependable, uniform protection in every roll.

"SCOTCHRAP" Brand Pipe Protection Tapes are being used by major utilities, gas, and pipeline companies and contractors and have been proved to be sound, practical, time-saving tools that provide positive, dependable corrosion protection.

COATING REQUIREMENTS

Protective coatings are the main line of defense against corrosion. While a variety of different materials are available, the chosen coating *must* have a certain number of properties to do the job. Listed below are the properties an "ideal" coating should have. "SCOTCHRAP" Tapes possess the best cross-section of these coating requirements.

- High adhesion
- Good electrical properties
- Good physical properties
- Good chemical resistance
- Wide temperature operating range
- Bacteria and fungus resistance
- Be easily applied
- Have long term stability of all properties.



In Distribution Systems



In Gathering Systems

Positive adhesion is a must, as the coating can protect only if it remains in place on the pipe. There are several forces acting on the coating; soil stress caused by soil movement due to alternate wetting and drying of the soil and thermal expansion and contraction of the pipe. These forces tend to cause sliding of the tape. A soft adhesive will slip under its own tension and expose substantial areas of bare metal. For this reason, "SCOTCHRAP" Tapes have a firm adhesive that has high resistance to shearing. In the event that damage should occur during handling and backfilling, a firm hi-tack adhesive keeps the exposed area to a minimum. "SCOTCH-

ADHESION

RAP" Tapes have adequate adhesion to prevent loosening at impact areas. They also resist cathodic protection forces that blister or lift the coating.

Soil Stress tests performed by the National Bureau of Reclamation showed that "SCOTCHRAP" Brand Pipe Protection Tapes passed 25 cycles of soil stress with only slight wrinkling. Most other tapes failed in 25 cycles or less. This illustrates the importance of a well designed adhesive and backing. "SCOTCHRAP" tapes stay where you put them—providing positive corrosion protection.



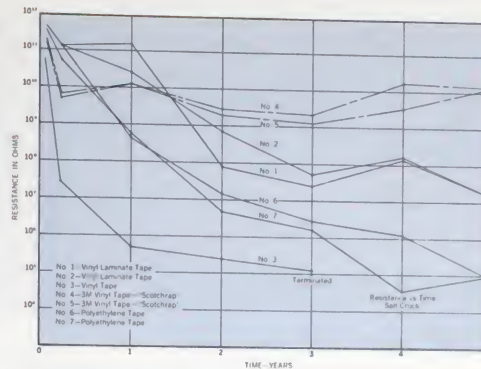
One type of shear adhesion test: $\frac{1}{2}$ sq. in. of each tape is bonded to a steel plate. A 1000 gram weight applies a shear force on adhesive. "SCOTCHRAP" Tape remains in place.

ELECTRICAL PROPERTIES

Corrosion is an electro-chemical phenomenon in which the flow of electric current is essential. The coating must stop the flow of electric current to stop corrosion. It is important that the coating retain its electrical properties at a high level during the expected life of the pipe.

The salt crock test is a standard method of comparing electrical properties of coatings. Of the two salt crock tests run by the 3M Laboratory (cathodic and anodic tests), it has been found that the cathodic test is usually much more severe. The graph shows the resistance of several tapes and "SCOTCHRAP" Tapes in a cathodic salt crock over a period of five years.

"SCOTCHRAP" Tapes are designed to be a permanent barrier to current flow. After five years of service, they continue to provide the same level of protection they did when first installed. In addition, salt crock tests also show that water absorption and transmission, which occurs with all coatings, has not affected their electrical properties. The electrical properties remain stable at a high level during the expected life of the pipe.



"SCOTCHRAP" Tapes are designed to be a permanent barrier to current flow. Initial resistance of "SCOTCHRAP" is not as high as some other tapes but, after 2, 3, 4 and 5 years of service, "SCOTCHRAP" continues to provide the same level of protection it did when it was installed. High initial resistance is of little importance if after several years the resistance has dropped below an acceptable value.



"SCOTCHRAP"
Tape No. 50

Other Vinyl Tape

Polyethylene
Tapes

Coal Tar
Mill Wrap

Wax
Mill Wrap



PHYSICAL/MECHANICAL PROPERTIES

Regardless of how good adhesion and electrical properties are, the coating cannot provide protection if it is damaged during or after installation. A properly designed coating needs adequate physical strength. "SCOTCHRAP" Tapes have excellent abrasion resistance—resistance to cracking, checking or stress cracking—good impact and tear resistance.

In order to illustrate the toughness of "SCOTCHRAP" Tape and compare it to the relative performance of other coatings, the 3M Laboratory has developed the rolling barrel test. This test is more severe than any condition expected in the field. It provides a good comparison of the relative performance of various coatings.

Note: Any known coating can be permanently damaged by careless workmanship just as metal pipe can be bent or marred.

The pictures left show test samples after 200 hours of rotation. Test procedure:

Test samples consist of coated pieces of one-inch pipe rigidly mounted inside a five gallon pail. The pail is charged with 2½ gallons of coarse aluminum oxide grit and 1½ gallons of water. The pail is sealed and then rotated at a surface speed of 160 feet/minute for 200 hours. The results clearly demonstrate the superior abrasion and puncture resistance and excellent bond strength of "SCOTCHRAP" Tapes.

CHEMICAL RESISTANCE

No coating is resistant to all chemicals. "SCOTCHRAP" Tapes are designed to resist most commonly encountered commercial chemicals and chemical vapors. They are highly resistant to most petroleum products and to the action of soil acids, alkalies and salts.

WIDE TEMPERATURE OPERATING RANGE

A coating must not become brittle and easily damaged at freezing temperatures, nor must it flow or sag in summer heat. Unbalanced properties make application difficult and result in coating damage in storage and handling. At the present time, no one plastic tape performs at all temperature ranges. If the tape is designed for cold weather application, it will be very soft at 80° F. If it is designed for warm weather, it will be brittle when applied at cold temperatures. "SCOTCHRAP" tapes are supplied in two constructions to handle cold and hot weather application conditions. If the temperature is above 50° F, "SCOTCHRAP" Tapes Nos. 50 and 51 can be used. "SCOTCHRAP" Tape No. 40, as close to an all weather tape as is available, can be applied at temperatures as low as 10° F. No. 40 can be applied at warm temperatures but do not over stretch. Once in place, temperature variations between -70° C (-94° F) to +80° C (176° F) do not affect the performance of "SCOTCHRAP" Tapes.

FUNGUS RESISTANCE

The use of a fungicide in a coating is effective only until the fungicide is used up. "SCOTCHRAP" Brand Tapes are designed to be funginert. A funginert material is one that is completely neutral to fungi. It will not halt nor will it support any of the life processes of the fungi, but it does not in any way contribute nutrient to the fungi. If a material does not furnish nutrient to fungi, it is not destroyed by the fungi. Only raw materials that are not attacked by fungus are chosen for use in "SCOTCHRAP" Tapes.

EASILY APPLIED

A coating that is easy to put on, saves money. With a little practice, "SCOTCHRAP" Tapes can be applied uniformly without wrinkles and gaps, even by unskilled workmen. This assures maximum corrosion protection with minimum effort. You are assured of a better job when you use "SCOTCHRAP" Tapes.

LONG TERM STABILITY OF ALL PROPERTIES

If a coating fails in any property, the corrosion protection is lessened or eliminated causing possible extra expense and hazard. "SCOTCHRAP" Tapes are placed in test areas in the United States where corrosion attack is unusually severe. Test panels returned from exposure sites after six years aging, show no significant change in the protection or physical and electrical properties of the tapes. In addition to the outdoor exposure tests, laboratory testing devices such as weatherometer, accelerated heat aging, and radiation resistance tests are all used to evaluate the aging properties. All these tests show that "SCOTCHRAP" Tapes are stable.

Field applications dug up after many years of service proved that "SCOTCHRAP" Tapes were providing excellent corrosion protection. "SCOTCHRAP" Brand Pipe Protection Tapes properly applied will provide lasting corrosion protection to all metal surfaces above and below the ground.

JEERING VOLTAGE

Holiday detectors are used to check coatings for holes, voids, contamination, cracks and damaged areas. Usually a high voltage detector is used and the holiday is detected by spark discharge. It is important to select the jeeping voltage at a level which will locate existing holidays, but will not cause holidays at points of high electrical stress. A detector set at a DC voltage of 150-200 times the mil thickness of the coating is sufficient to find holidays.

TYPICAL APPLICATION SPECIFICATIONS

In Drilling Rigs



In Tank Farms



In Chemical Plants

Surfaces to be wrapped shall be clean and dry. Oil and grease, if present, should be removed with a rag and suitable solvent, such as heptane or trichlorethylene. Old or superficially rusted and reconditioned pipe shall be primed using "SCOTCHRAP" Brand Pipe Primer. Weld beads shall be covered with one wrap or layer of tape prior to spiral wrapping. Tape shall be spirally wrapped the length of the pipe using one-half lap for double thickness or $\frac{1}{2}$ " overlap depending on the individual installation.

Rock shield or roofing felt may be used as additional protection in severe backfilling conditions.

Whenever possible, pipe shall be wrapped in place. If it is necessary to wrap above ditch, protection at sling points using rock shield or roofing paper is required. When pipe is mill-coated, tape shall be used for fittings and joints. Remove kraft paper wound over tar coating. Tape shall then be spirally wrapped, as mentioned above, with one complete wrap starting on mill coating 3" from edge. Welded joints may also be taped using the cigarette wrap system. Wrap narrow band of tape over weld bead for extra protection. Use one width of tape that is wide enough to cover 3" of the mill or yard coating on each side of the bare steel joint area. Material shall be polyvinyl chloride pressure-sensitive tape either .010" or .020" thick; Minnesota Mining and Manufacturing Company, "SCOTCHRAP" Pipe Protection Tape.

APPLICATION PROCEDURES FOR TAPING WELDED JOINTS, TEES AND PATCHING

Coating welded joints, turns, tees and short sections in the field, is easy with "SCOTCHRAP" Brand Pipe Protection tapes. Several methods are listed below.



The joint area to be taped should be clean and free from sharp metal burrs.

PREPARING JOINT SURFACES

1. Remove kraft paper wound over tar coating. (If paper sticks, remove it with a wood rasp or by heating it slightly with a torch. Electric paint scrapers can also be used.)
2. Remove or smooth sharp weld burrs with a file, axe or ballpeen hammer.
3. Remove excessive rust or mill scale with a wire brush.
4. Dust or moisture on pipe should be removed with a rag and alcohol, or other suitable solvent.

START TAPING

Before taping a joint, apply one wrap of tape over weld bead for extra protection (2-inch wide tape is sufficient for this purpose). At each mill wrap shoulder, apply one strip of "SCOTCHRAP" Brand Pipe Putty. This provides a smooth build-up for taping, eliminating the need to taper the mill shoulder. Begin the main application with one complete wrap of tape starting 3 inches on shoulder of mill coating.

In taping pipe, it is usually easier for one man to straddle the pipe and tape alone if the pipe is 8 inches or less in diameter. Two men can usually do a better and faster job on a large pipe by using a short length of $\frac{3}{4}$ inch pipe or a stick as a handle. Tape should be applied according to the engineer's specifications.



FINISH TAPING

Finish taping by making one complete wrap over the opposite shoulder of mill coating with 3 inches of tape on the coating shoulder.

PATCHING

"SCOTCHRAP" makes a quick, positive patch for damaged sections of mill coating. If damaged area is deep, pipe putty can be used to level to mill wrapped surface before applying tape.



Apply pipe putty to shoulders and irregular surfaces. If main is mill coated, fill void at base of tee with putty.

TAPING TEES

A new system of protecting hard-to-wrap fittings has been developed, using "SCOTCHRAP" Brand Pipe Protection Tape. Most fittings wrap best with 2 inch and 1 inch tape, although the principle can be expanded to larger fittings using wider tape. The pictures that follow illustrate the correct method of wrapping common fittings quickly and positively.



Apply 2-inch tape over compression nut—around tee saddle—around tee elbow junction. Use enough tension on these and succeeding wraps to get conformable, wrinkle-free surface. Place strips of tape over putty on the main at the base of the tee.



Unroll 2-inch tape and split end in half for length of about 4 inches (depending upon tee size). Place end of split at base of tee and wrap flaps around tee base.

Bring tape around main and over putty on one side of tee, around main and over putty on other side of tee, and around main to back of tee. About 4 inches of tape should be left above tee base.



The 4-inch end should be split and the flaps wrapped around the base of the tee.

(The taping of the main can be done now or after the tee is completed.)



As a guide to the application of "SCOTCHRAP" Brand Pipe Protection Tapes the following charts are provided.

PIPE COVERAGE TABLES

WELDED JOINTS

Pipe Size	Squares/ Joint*
1"	.006
2"	.010
4"	.019
6"	.028
8"	.038
10"	.047
12"	.056
14"	.061
16"	.070
18"	.079
20"	.087
24"	.105
30"	.130

*Includes 15% waste factor.

Pipe Size in Inches		Recom- mended Tape Width	Minimum Tape Overlap	Squares of Tape Needed Per 100 Lineal Feet of Pipe		Number of Square Feet Per 100 Lineal Feet of Pipe	Pipe Size in Inches		Recom- mended Tape Width	Minimum Tape Overlap	Squares of Tape Needed Per 100 Lineal Feet of Pipe		Squares of Tape Needed Per 100 Lineal Feet of Pipe	Number of Square Feet Per 100 Lineal Feet of Pipe
ID	OD			Minimum Overlap	Half- Lapped		ID	OD			Minimum Overlap	Half- Lapped		
1/2"	.84"	1"	1/4"	.294	.44	22.0	10"	10.75"	6"	1/2"	3.070	5.629	281.4	
3/4"	1.05"	1" 2"	1/4"	.367 .338	.55	27.5			6"	1/2"	3.002	3.002	6.152	307.6
1"	1.32"	1" 2"	1/4"	.461 .425	.691	34.6	11"	11.75"	6"	1/2"	3.356	3.281	6.676	333.8
		2" 4"	1/2"	.395	3.641	3.560			6.676	333.8				
1 1/4"	1.66"	2"	3/8"	.535	.869	43.5	12"	12.75"	6"	1/2"	3.998	3.910	7.330	366.5
1 1/2"	1.90"	2" 4"	1/2"	.612 .568	.995	49.7			6"	1/2"	4.570	4.468	8.378	418.9
2"	2.38"	2" 4"	1/2"	.767 .712	1.246	62.3	16"	16"	6"	1/2"	5.141	4.688	9.425	471.3
2 1/2"	2.88"	2" 4"	1/2"	.928 .862	1.508	75.4			6"	1/2"	5.027	5.027	10.472	523.6
3"	3.50"	2" 4"	3/8"	1.128	1.833	91.6	20"	20"	6"	1/2"	5.712	5.585	10.472	523.6
		4"	1/2"	1.047	6.283	6.144			11.519	576.0				
3 1/2"	4.00"	2" 4"	3/8"	1.289	2.094	104.7	22"	22"	6"	1/2"	6.283	6.144	12.566	624.9
4"	4.50"	2" 4"	1/2"	1.450 1.346	2.356	117.8			6"	1/2"	6.854	6.702	13.614	680.7
4 1/2"	5.00"	4"	1/2"	1.496	2.618	130.9	26"	26"	6"	1/2"	7.427	7.261	14.688	735.4
5"	5.57"	4" 6"	1/2"	1.667 1.984	2.916	145.8			6"	1/2"	8.568	8.378	15.708	785.4
6"	6.63"	4" 6"	1/2"	1.894	3.471	173.6	30"	30"	6"	1/2"	9.710	9.495	17.802	890.1
7"	7.63"	4" 6"	1/2"	2.283 2.179	3.995	199.7			6"	1/2"	10.282	10.053	18.850	942.5
8"	8.63"	4" 6"	1/2"	2.582 2.465	4.519	255.9	36"	36"	6"	1/2"	10.282	10.053	18.850	942.5
									6"	1/2"	9.835	9.835		

"SCOTCHRAP" BRAND PIPE PRIMER—1 Gallon Will Cover up to 500 Square Feet Depending on the Surface Condition of the Pipe. A square is 100 sq. ft. of tape. Examples: 2 RLS 6" x 100 ft., 3 RLS 4" x 100 ft., 6 RLS 2" x 100 ft. While the above chart gives pipe coverage data for most common sizes, the following formula may be helpful for non-standard items: Squares of Tape = $\pi (LP) (DP) \frac{TW}{1200 (TW-OV)}$ $\pi = 3.1416$, LP = Length of Pipe (Ft.), DP = Outside Diameter of Pipe (In.), TW = Tape Width (In.), OV = Overlap of Tape (In.)

PHYSICAL / ELECTRICAL PROPERTIES

Physical Properties	Test Method	No. 40 Cold Weather	No. 50	No. 51
Color Backing	—	Green	Black	Black
Color Adhesive	—	Green	Green	Green
Thickness (Overall)	D-1000	.010"	.010"	.020"
Elongation at Break (%)	D-1000	250	225	350
Tensile Strength (lbs. per inch of width)	D-1000 (1" between jaws)	25	25	50
Adhesion (oz. per inch of width)	D-1000	30	30	30
Conformance Factor @ 30°F (lbs. to stretch 1-inch width 20%) @ 0°F	D-1000	21 45	26	52
Abrasion Resistance	3M (Rolling barrel)	200 hrs. (Tape still intact)	200 hrs. (Tape still intact)	400 hrs. (Tape still intact)
Tear Resistance (Grams)	D-689	1500	1500	3000
Machine Direction	D-689	1900	1700	3500
Cross Direction				

Electrical Properties	Test Method	No. 40 Cold Weather	No. 50	No. 51
Salt Water Resistivity	Salt Crock (3 Volts-Cathodic)	1x10 ⁴ Ohm-Ft.	1x10 ⁴ Ohm-Ft.	1x10 ⁴ Ohm-Ft.

Tests are conducted in accordance with ASTM Test Methods unless otherwise indicated.

Values listed in the table are average and are not to be taken as maximum or minimum for specification work.

Values show relative performance under standard test conditions; tests under actual service conditions are recommended.

MAXIMUM OPERATING TEMPERATURE IS 80°C (176°F).

Scotchrap[®] PIPE PRIMER

"SCOTCHRAP" Brand Pipe Primer is a thixotropic fast drying primer for metal surfaces developed especially for use with "SCOTCHRAP" Brand Pipe Protection Tapes. The primer increases tape bond and provides a clean, dry taping surface. It will also anchor surface dust and remove surface moisture.

"SCOTCHRAP" may be applied by paint brush or spray coat. An average paint coat is sufficient for all but extremely rusted pipe. Primer dries in a few minutes under average conditions. Tape may be applied any time after primer loses shine. This will take 1 to 5 minutes depending upon humidity, wind, and temperature.

One gallon will cover up to 500 square feet depending on the surface condition of the pipe.



Scotchrap[®] PIPE INSULATION PUTTY

"SCOTCHRAP" Brand Pipe Insulation Putty, a 100% solids, is used as a build-up compound to provide a smooth, waterproof taping surface on fittings and field joints. Supplied in handy one foot lengths, "SCOTCHRAP" Pipe Putty stays soft and pliable—simply press putty into place at irregular surfaces, mold with finger pressure and tape using standard methods.



A free pocket size booklet entitled "Tape It Easy" is available for your workmen. It gives more information on application methods as well as useful specifications for "SCOTCHRAP" Brand Pipe Protection Tapes.

WHERE TO ORDER

HOW TO ORDER

"SCOTCHRAP" Pipe Protection Tapes are manufactured by Minnesota Mining and Manufacturing Company, St. Paul 19, Minnesota. For further information or the address of your local supplier, please contact our nearest branch office.

Order by square. A square is 100 square feet of tape; examples would be two rolls 6" x 100 feet—three rolls 4" x 100 feet. For quantity required, see Pipe Coverage tables. "SCOTCHRAP" Brand Pipe Protection Tapes are available in 1", 2", 4", 6", 8", 12", and 18" widths by 100 foot rolls.

"SCOTCHRAP" Brand Pipe Primer is available in one-gallon pails. One gallon will cover up to 500 square feet, depending on the surface of the pipe.

"SCOTCHRAP" Brand Pipe Insulation Putty is packed in individual boxes (60 one-foot lengths per box), 10 boxes per carton.

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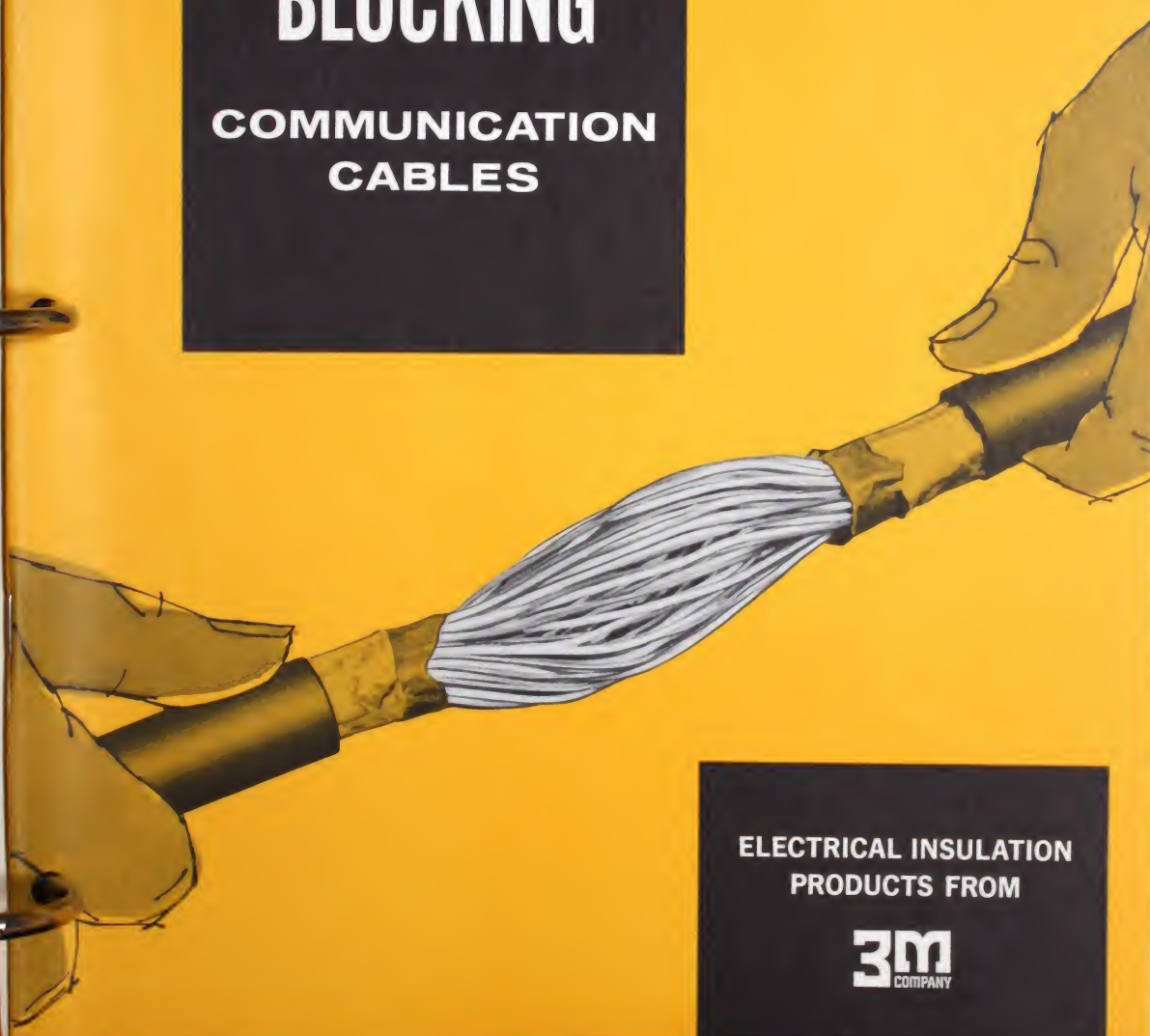
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SPlicing and **BLOCKING**

**COMMUNICATION
CABLES**



**ELECTRICAL INSULATION
PRODUCTS FROM**

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We are anxious for you to know more about "SCOTCH" Brand Electrical Products, particularly those materials designed for the communications industry. Many people, from all corners of the world, have contributed to this book either by helpful suggestions or know-how. We hope that you will find the brief resume of each product helpful and that the tried and proven methods, as well as the new techniques, find a place in your system.

The data we supply here is fundamental, of course, but our distributors and field engineers are ready to work with you and provide additional information on products and applications.

The photograph of the 3M Electrical Products Laboratory represents part of your guarantee—a guarantee of exceptional quality and service each time you specify or use one of 3M's Electrical Products.

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NO. 33 A RELIABLE AND DEPENDABLE SPlicing TOOL!

"Scotch" Brand Electrical Tape No. 33 is a tough vinyl plastic tape well known to splicers and linemen throughout the world. Its excellent adhesive system does not break down or get brittle with aging . . . keeps the tape wrapped tight long after most tapes fail. No. 33 combines excellent mechanical strength, copper corrosion resistance and superior weathering characteristics with thinness and high conformability. It resists acid, oil and abrasion.



TYPICAL APPLICATIONS

- Weather protection over splices on aerial cable.
- Sealing and insulating splices on direct burial cables.
- Spot harnessing on control panels.

Splicers use No. 33 as an *extra tool* for many difficult insulating and sealing jobs quickly and easily.



PROPERTIES

Color	Over-All Thickness	Tensile Strength	Elong. At Break	Adhesion Oz./In. Width	Insulation Resistance Meg-Ohms	Electric Strength	Corrosion Factor
Black	.007"	20	175%	30	> 1 x 10 ⁶	9800 v.	1.0

NO. 88 FOR COLD WEATHER APPLICATIONS

"Scotch" Brand Electrical Tape No. 88 has been developed for easy application in cold weather. Temperatures down to 0°F, present no problem, yet it retains its toughness and conformability even in warm weather.



Color	Over-all Thickness	Tensile Strength	Elong. At Break	Adhesion Oz./In. Width	Insulation Resistance Meg-Ohms	Electric Strength	Corrosion Factor
Black	.0085"	20	250%	20	> 1 x 10 ⁶	10,000 v.	1.0

Scotchfil

BRAND

ELECTRICAL INSULATION PUTTY

This is a non-corrosive synthetic rubber insulating compound in tape form. Its extra thickness ($\frac{1}{8}$ " or 125 mm) and width ($1\frac{1}{2}$ " or 38.1 mm) make "Scotchfil" the most economical, speedy and easy method of sealing and padding irregular shapes and filling voids.

"Scotchfil" has excellent molding characteristics and applies cleanly without waste. After application, it forms a homogenous mass around any irregular shape that will not dry out, soften, become brittle or hard. It bonds only to itself, making re-entry easy. "Scotch" Brand No. 33 or 22 Electrical Tape completes the outer protection and electrical requirements of the splice.



TYPICAL APPLICATIONS

- Filling major irregularities and voids
- To obtain a uniform base for further taping
- Building a moisture seal

Color	Thickness	Electric Strength	Insulation Resistance Meg-Ohms	Corrosion Factor	CU Corrosion	Silver Corrosion	H ₂ O Absorption
"Scotchfil" Black	$\frac{1}{8}$ " (125mm)	400V per mil	$> 1 \times 10^5$	1.0	none	none	0.4%
"Scotch" No. 23 Black	30 mils	600V per mil	$> 1 \times 10^6$	1.0	none	none	0.4%

NO. 23 ELECTRICAL TAPE

"Scotch" No. 23 Electrical Tape is essentially the same material as "Scotchfil" Electrical Insulating Putty. It has the same self-fusing characteristics, moisture sealing ability and ease of application. It is available in $\frac{1}{4}$ ", 1", $1\frac{1}{2}$ " and 2" widths (19.1, 25.4, 38.1 and 50.8 mm respectively) by 30 feet (9.15 m). As with "Scotchfil", an overwrap of "Scotch" No. 33 or 22 will complete the electrical requirements of the splice.

TYPICAL APPLICATIONS

- Where the conformability of a thinner tape is required for a moisture seal or padding.
- As an important part of the popular "auxiliary lead sleeve method" of splicing plastic insulated (PIC) cable.



NO. 22 FOR ADDITIONAL MECHANICAL STRENGTH AND ABRASION RESISTANCE

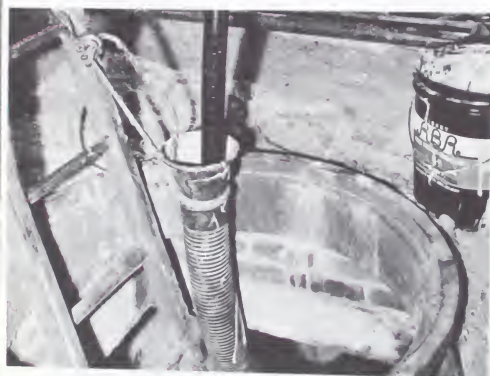
This heavy duty splicing tape has all the desirable properties of general purpose "Scotch" No. 33; additionally its extra thickness provides increased mechanical strength, abrasion resistance and weathering characteristics.

TYPICAL APPLICATIONS

- Where mechanical abuse may be present in direct burial applications
- Where an "over-night" moisture proof enclosure is necessary on unfinished aerial splices
- As a permanent overwrap on the finished job



Color	Over-All Thickness	Tensile Strength	Elong. At Break	Adhesion Oz./in. Width	Insulation Resistance Meg-Ohms	Electric Strength	Corrosion Factor
Black	.010"	30	250%	30	$> 1 \times 10^6$	11500 v.	1.0



Scotchrap PIPE PROTECTION TAPES BRAND NO. 50 AND NO. 51

Designed specifically to protect pipe, conduit and lead covered cable from corrosion.

"Scotchrap" is tough, has a high degree of insulation resistance and resists the action of acids, alkalis, fungi, and bacteria. One other feature—high conformance—makes "Scotchrap" the perfect anti-corrosion tape.

AVERAGE PROPERTIES

	Color	Over-All Thickness	Tensile Str. Lbs./In. Width	Elongation at Break	Adhesion Oz./In. Width
50	Black	.010"	25	225%	35
51	Black	.020"	50	350%	35
	Electric Strength	Insulation Resistance Meg-Ohms	Corrosion Factor	Adhesion (Shear)	Conductance Micro Micro-Mhos
50	9500 v.	> 1 x 10 ⁶	1.0	80 Min. IKG/1/2" Sq.	< 1.0
51	18000 v.	> 1 x 10 ⁶	1.0	80 Min. IKG/1/2" Sq.	< 1.0

TYPICAL APPLICATIONS

- "Scotchrap" No. 50 provides corrosion protection and insulation on lead covered cable, above and below ground.
- Tough "Scotchrap" No. 51 gives abrasion protection on cable being pulled through conduit.

Scotchrap NO. 40 ... FOR COLD BRAND WEATHER APPLICATIONS

"Scotchrap" Brand Pipe Protection Tape No. 40 is a special cold weather formulation designed specifically to be conformable over a broad temperature range. The green PVC tape can be easily applied at temperatures as low as -5° F.

Like No. 50 and 51 it has excellent insulation resistance and electric strength. No. 40 is also designed to be funginert. A balanced high-tack adhesive system is used. Its internal strength stops tape displacement caused by movement of soil or pipe. It too resists the action of acids, alkalis, salts petroleum oils, and refined products such as gasoline and naphtha.

PROPERTIES

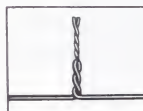
Color	Thickness	Elongation at Break	Tensile Strength Lbs./In. of Width	Adhesion Oz./In. of Width	Electric Strength	Insulation Resistance Meg-Ohms
Green	.010"	225%	25	25	10,000 volts	> 1 x 10 ⁶

Irvington BRAND SILICONE FILLED SPLICE SLEEVES

Are manufactured from weather resistant polyethylene and carefully filled with a corrosion resistant silicone grease. These sleeves are applied quickly and easily to insure positive splice protection. The silicone grease maintains constant viscosity at high and low temperatures which permits simple re-entry.

Catalog No.	Diameter	Color	Boxed—Pieces
TS 121	.085"	Yellow	110
TS 122	.105"	Green	110
TS 123	.125"	Clear	110
TS 124	.145"	Red	110
TS 125	.165"	Blue	110
Bulk—Pieces			
TS 111	.085"	Yellow	550
TS 112	.105"	Green	450
TS 113	.125"	Clear	350
TS 114	.145"	Red	275
TS 115	.165"	Blue	225

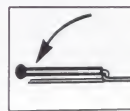
Use these moisture proof splice sleeves on each individual conductor pigtail splice on all sizes of multi-conductor telephone and control cable.



Strip Wire & Make Pigtail Splice



Slip Filled Sleeve Over Splice



Bend Parallel to Cable & Tape Splice

Scotch BRAND ELECTRICAL TAPE NO. 49

Is designed specifically for moisture vapor barrier continuation. This pressure sensitive aluminum foil tape is specified for many moisture proofing jobs in the communications industry.

Number 49 is packaged in rolls two inches by 20 feet (50.8 mm x 6.1 meter) and four inches by 20 feet (101.6 mm x 6.1 meter) for convenient handling and application.



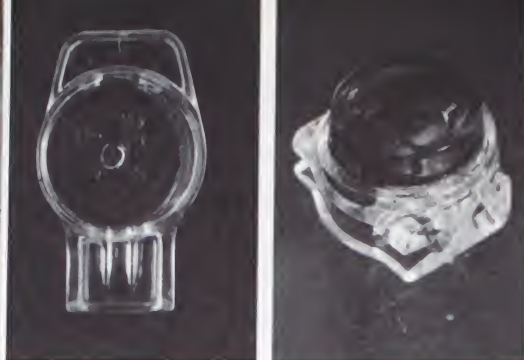
TYPICAL APPLICATION

As a moisture vapor seal in the "auxiliary lead sleeve method" of splicing plastic insulated (PIC) cables.



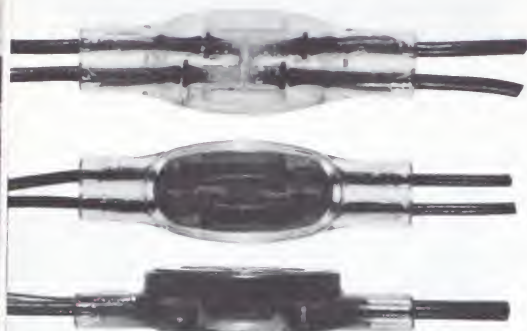
PROPERTIES

Type of Backing	Thickness in Mills	Tensile Strength Lbs./In.	Elongation % at Break	Adhesion Oz./In.
.003 Aluminum Foil	5	30	10	45



UR

UG



U1Y, U1B, U1R

Scotchlok

U-ELEMENT CONNECTORS
BRAND

THE FIRST SELF-SEALING, SELF-STRIPPING, PRE-INSULATED CONNECTOR FOR COMMUNICATIONS CABLE THAT IS FUNCTIONALLY EQUAL TO TWIST AND SOLDER JOINTING METHODS

The "Scotchlok" U-Element Connector is made of transparent thermoplastic material, filled with silicone grease. It incorporates a metal connector element that provides a complete splice easier, faster and more conveniently than *any* method now in use.

SELF-STRIPPING, SELF-SEALING AND PRE-INSULATED
—The joint is made, insulated and sealed in one easy step . . . saves time, reduces cost. The connector element provides the electrical and mechanical joint . . . the thermoplastic sleeve insulates and protects . . . and the factory installed silicone grease moisture seals the joint.

YOU CAN VISUALLY INSPECT THE COMPLETED JOINT
—The transparent pod allows visual inspection to insure full insertion of the conductors. The position of the colored button shows that the installation is complete. If the button is up, joint is not complete; if it is down, the joint is complete.

TYPICAL APPLICATIONS

- Virtually anywhere a splice is made on nearly every gauge of wire used by the communications industry.
- Used on wire insulated with plastic (including high density polyethylene), enamel, rubber, teflon and other materials.



E-9B Crimping Tool

The following chart shows the wide variety of wire sizes that can be accommodated with "Scotchlok" Brand U-Element Connectors.

Connector	Wire Size Range	Electric Strength		Insulation Resistance
		Dry	Wet	
UR 2 or 3 Wire Connector	*Any 2 or 3 Wire Combination 19 AWG to 26 AWG Solid or 20 AWG to 26 AWG Stranded	Conductor to Ground		> 1 x 10 ⁶
		13,400 v.	11,000 v.	
UG Tap Connector	*Any 2 Wire Combination as above	Connector to Shield 3,250 v.	Not Applicable	> 1 x 10 ⁶
		Connector to Connector 6,500 v.	Connector not Moisture Proof	
U1Y 4 Way Tap Connector	16 AWG to 19 AWG Stranded or Solid	Conductor to Ground		> 1 x 10 ⁷
		23,400 v.	16,900 v.	
U1R Inline Full Pair Connector	Solid 19 AWG to 24 AWG Stranded 19 AWG to 22 AWG	Conductor to Ground		> 1 x 10 ⁷
		23,400 v.	> 10,000 v.	
U1B Inline Full Pair Connector	16 AWG to 19 AWG Solid or Stranded	Conductor to Conductor		> 1 x 10 ⁷
		10,000 v.	> 5,000 v.	
		Conductor to Ground		> 1 x 10 ⁷
		23,400 v.	> 10,000 v.	
		Conductor to Conductor		> 1 x 10 ⁷
		10,000 v.	> 5,000 v.	

*NOTE: Maximum Diameter of Insulated Conductor —.068" (19 AWG = .036" — 26 AWG = .016")
Connector resistance of all types is comparable to an equivalent length of conductor. Each connector has a pullout resistance of 75% of the wire's breaking strength and will withstand temperatures from —270°F. to +220°F.

Scotchcast

COMMUNICATIONS RESIN NOS. 11 and 12

Both of these "Scotchcast" Brand Communications Resins (Nos. 11 and 12) are packed in 3M's exclusive "Unipak" Containers designed for various sealing, splicing and blocking jobs which provide the user with a "factory-perfect" result in the field. Pre-measured and mixed in the "Unipak" Container, "Scotchcast" Resins Nos. 11 and 12 are two part liquid insulating materials that set hard in approximately 30 minutes.

"Scotchcast" No. 11 has been developed specifically for splicing and blocking paper/lead communication cables. This low viscosity resin is able to saturate paper insulation quickly and bonds firmly to the lead sheath for positive moisture protection.

"Scotchcast" No. 12 is used for splicing and blocking plastic insulated (PIC) cables. It is used in the 89-D series communications kits of the "Scotchcast" Resin Pressure Method discussed on page 9.



AVERAGE PROPERTIES OF "SCOTCHCAST" NOS. 11 and 12

NO. 11				NO. 12			
Property	Units	ASTM Test	Result	Property	Units	ASTM Test	Result
Electric Strength	volt/mil 1/8" sample	D-149-44	350	Electric Strength	Volts/mil 1/8" sample	D-149-44	400
Dielectric Constant	K, 60 cys	D-150-54T		Dielectric Constant	K 60 cys	D-150-54T	
	50% RH				50% RH		
	30°C		3.68		30°C		4.74
	60°C		7.4		60°C		6.50
Dissipation Factor	D, 60 cys	D-150-54T		Dissipation Factor	D 60 cys	D-154-54T	
	50% RH				50% RH		
	30°C		.026		30°C		.070
	60°C		.326		60°C		.41
Volume Resistivity	Ohm-Cm	D-257-54T		Volume Resistivity	Ohm-cm	D-287-54T	
	50% RH				50% RH		
	30°C		2.6 x 10 ¹³		30°C		2.7 x 10 ¹⁴
	60°C		2.5 x 10 ¹⁰		60°C		2.3 x 10 ¹⁰
Water Absorption	% 24 hr.	D-570-42		Water Absorption	% 24 hr.	D-570-42	
	23°C		.29		23°C		.198
	53°C		.80		60°C		.62
Tensile Strength	PSI	D-638-42T	3,600	Tensile Strength	PSI	D-638-42T	1520
Elongation	%		19.9	Elongation	%	D-638-42T	10%
Electrolytic Corrosion	Ratio	D-1000	1.0	Electrolytic Corrosion	Ratio	D-1000	1.0
Shrinkage During Cure	%		1/2 to 1 1/2	Shrinkage During Cure	%		.5 to 1.5
Water Resistance				Water Resistance			Excellent
Oil Resistance				Oil Resistance			Excellent

A.
Take a firm pinch on EACH of the flat sides of the "UNIPAK" container near the center barrier. Pull bag sides apart and roll thumbs through the barrier.

B.
Alternately squeeze ends of the "UNIPAK" forcing contents rapidly back and forth.

C.
Strip contents from corners with thumb and forefinger. Mix until color is uniform (30 to 40 vigorous squeezes).





89-D



89-C

Scotchcast

BRAND

COMMUNICATIONS KITS 89-D Series

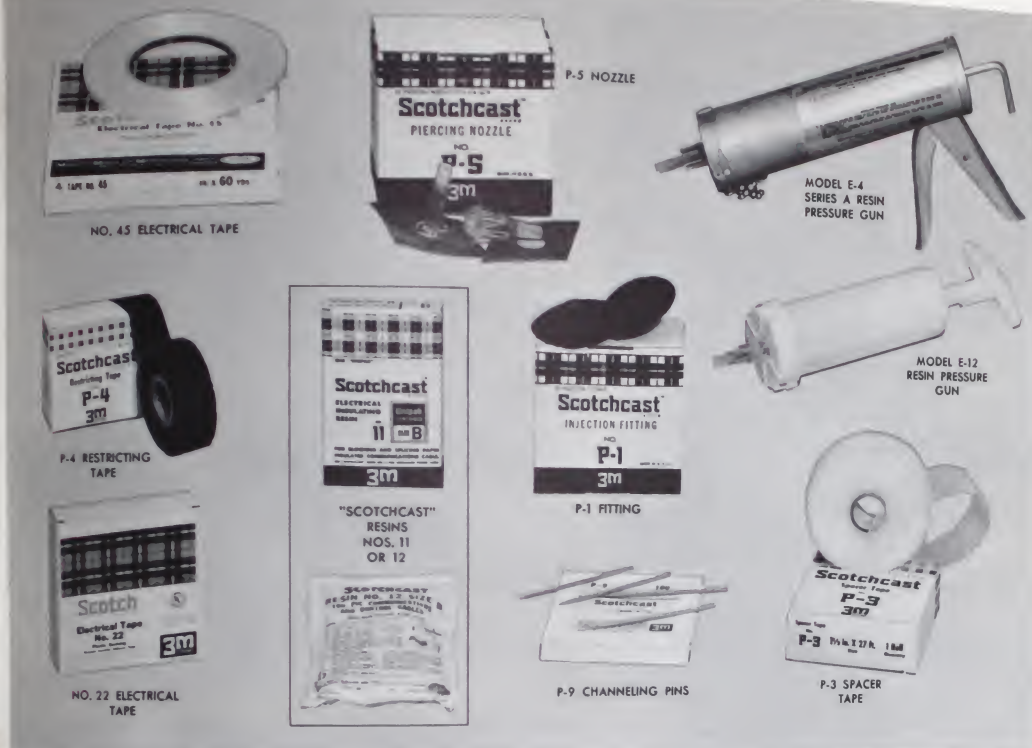
Communications Kits 89C and D Series are convenient splicing or blocking kits designed especially for insulating and moisture sealing plastic insulated (PIC) communications and control cables.

A new two-part room temperature curing epoxy resin "Scotchcast" Brand Resin No. 12 is the insulation/sealant for these kits. Packaged in the unique "Unipak" Brand Container, it cures to a hard impervious insulation at a temperature compatible to the upper temperature limitations of the primary insulation. This resin is thin enough to completely impregnate the conductor bundle of multi-conductor cable and forms a void-free, moisture-tight seal. Each kit contains all the materials needed to make the seal and a complete set of instructions. See page 14 for detailed instructions concerning use.

COMMUNICATIONS KITS 89-C Series

Communications Kits 89-C Series are a new system for end sealing plastic insulated cable (PIC). It eliminates service interruptions caused by moisture in underground installations. Each 89-C series kit contains all the material needed to end seal and by-pass (PIC) cables in a pedestal mount or cabinet. The resin comes in a pre-measured unique "Unipak" Brand Container in which it is mixed and poured directly into the molds, thus insuring the exact mixing ratios and considerably simplifying the end sealing operation. See page 16 for detailed instructions concerning use.





Scotchcast

BRAND

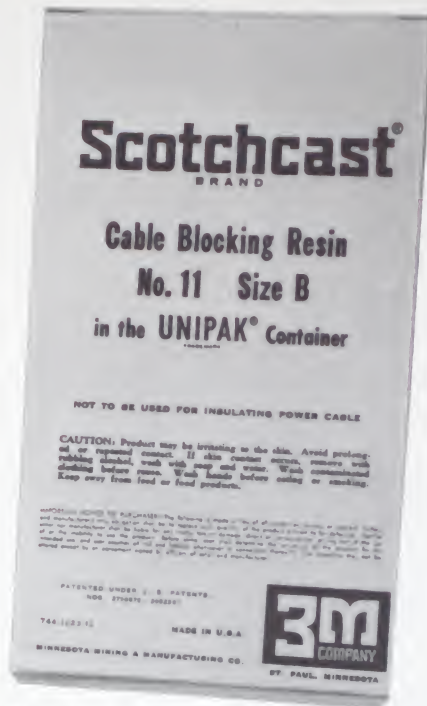
RESIN PRESSURE METHOD

This is a very flexible method of splicing and blocking. With only a few accessories a mold can be made to satisfy the exact dimensions and configurations of the joint or block.

An open mesh screen-like tape provides the framework for the epoxy resin injected under pressure. A liquid-tight plastic tape covers the mold and an injection fitting allows entry of the resin. Finally a low-stretch tape maintains the desired shape during injection.

The "Scotchcast" Resin Pressure Method may be used on lead or plastic sheathed cables and with conductor insulation of all types. The type of "Scotchcast" Communications Resin will depend on the type of cable in the system. "Scotchcast" No. 11 would be used for splicing and blocking paper/lead cables; No. 12 for plastic insulated (PIC) cables. The methods of building up different types of splices are explained with detailed engineering drawings on pages 23 - 27.





"Scotchcast" Brand Resin No. 11 for use on paper insulated cables.



"Scotchcast" Brand Resin No. 12 for use on plastic insulated cables.

RESIN SPLICES FOR COMMUNICATION CABLES

A. RESIN PRESSURE PROCEDURE FOR AN INLINE SPLICE WITH IMPREGNATED CORE

1. Where generally used?

A fully impregnated splice is a closure solidly filled with resin. As such, it gives the maximum protection from free moisture either internal or external to the cable. It is used in permanent installations where the possibility of re-entry is remote. This splice will make a moisture and air block in the cable. The Resin Pressure Splice can be made on any size cable or sheath opening with the same basic splicing materials.

2. Handling the Shielding on Plastic Insulated Cable.

The shielding is removed except for 1" at each end to allow for jumper wire attachment.

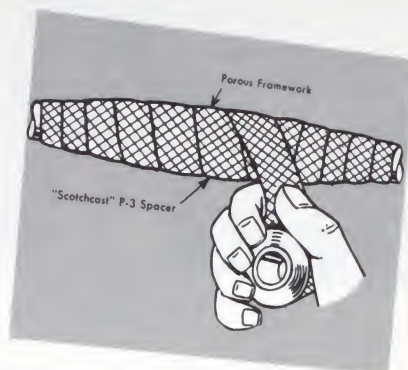
3. Make connections:

UR "Scotchloks" recommended for making connections on plastic insulated (PIC) cables.

4. Wrapping the "Scotchcast" Brand P-3 screen spacer tape.
- P-3 is a porous screen tape $1\frac{1}{2}$ " wide. It is wrapped around the splice to build up the desired size and shape of closure. It acts as a porous frame-work for the plastic tape envelope. Its porosity insures complete resin saturation.

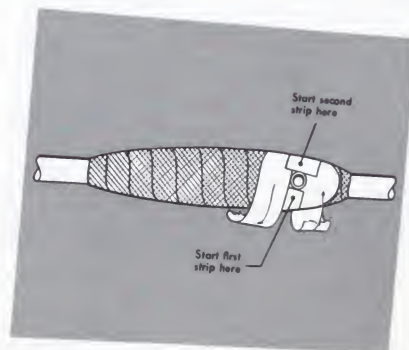
Standard taping methods are used as shown in the illustration. First—Wrap low spots at one end with spacer tape to form a uniform diameter build-up.

Second, wrap a layer of spacer tape across the bundle and build up the low spots on the other end. Finally, wrap the spacer tape to the desired thickness over the entire splice by "level-winding". The tapers at each end of the splice are formed by stopping each layer short of the preceding layer.



5. Installing the P-1 Injection Fitting.

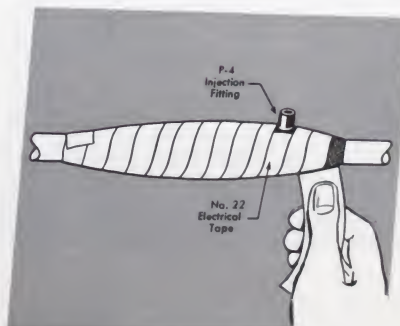
The P-1 Injection Fitting is located near one end of the splice. It has a built-in check valve to retain resin in the splice when the gun is removed.

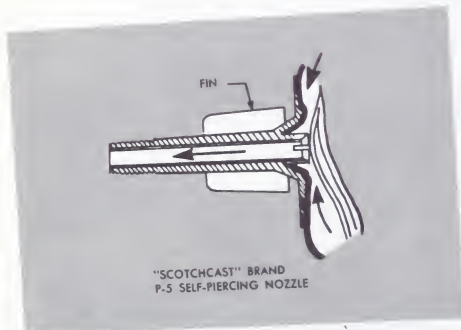
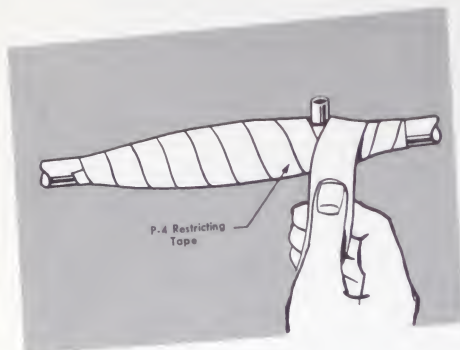


6. Plastic Tape Envelope Application:

The envelope is one layer, half-lapped of $1\frac{1}{2}$ " No. 22 "Scotch" Brand Electrical Tape. It must be applied smoothly without gaps or wrinkles to insure against leaks.

- Start on one side of the injection fitting as shown, and continue half-lap wrapping to a point one inch beyond the end of the spacer tape. Pull the tape firmly, stretching it to conform to the spacer buildup. Do not let gaps or wrinkles appear on the laps to ensure a liquid-tight envelope.
- Start the second strip on the opposite side of the injection fitting and proceed as before.





7. Restricting Tape Application

Since the plastic tape envelope will stretch under pressure, it must be restrained during resin saturation. Two layers of a non-stretching tape ("Scotchcast" P-4 Restricting Tape) are wrapped firmly over the plastic tape envelope. Starting at one end, half lap one serving of P-4 Restricting Tape across the splice; then reverse and half lap the second serving back to the starting point as shown at left. The P-4 Restricting Tape may be removed if desired, after the resin has hardened.

8. Vent holes

Before saturation, a small hole is punctured only through the P-4 Restricting Tape and Plastic envelope at the end of the spacer buildup farthest from the injection fitting. The puncture is made parallel to the cable to avoid cable sheath damage. Inject the resin until a droplet of resin appears at the vent and then pierce a similar hole at the end closest to the injection fitting. Continue injecting until resin appears at this second vent.

9. Loading and Injecting Instructions

For use with "Scotchcast" Brand Model E-4 Resin Pressure Gun.

a. "Unipak" Container Preparation

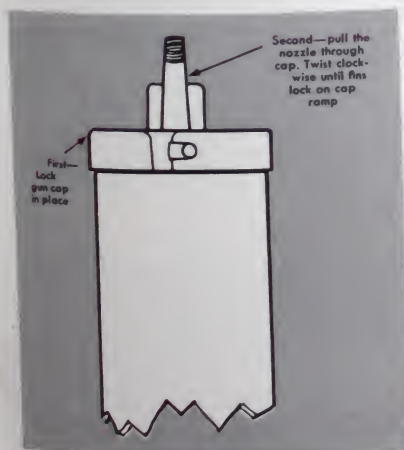
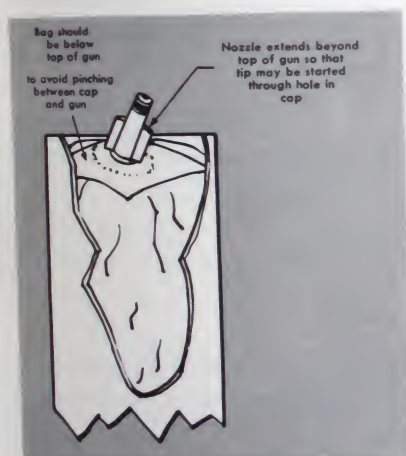
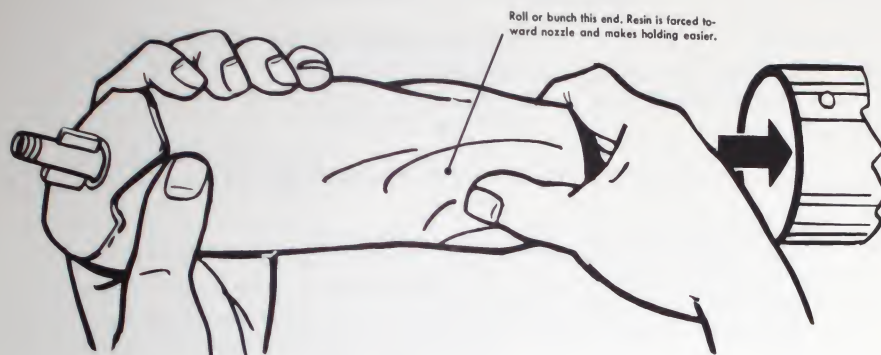
1. Mix the contents of the "Unipak" using the instructions in the package. Always use "Unipak" Size C in preference to Sizes B or A when the splice requires over 6 fluid ounces of resin.

CAUTION—The working life of these Resins is limited. Preparation, loading, and saturation must be completed without delay. This is particularly important when several "Unipaks" must be injected into a single splice.

2. Remove paper liner from a tape patch (packed with the P-5 Nozzles).
3. Place hole, in tape patch, over the P-5 Nozzle and center the assembly near the narrow edge of the *mixed* "Unipak".

b. Loading the Resin Pressure Gun

1. Retract gun piston.
 - a. Grasp the "Unipak" in both hands, holding it roughly cylindrical so it can easily slide into the gun barrel.
2. Roll or bunch the end of the "Unipak" opposite the nozzle. This will force some resin toward the nozzle end and improve the cylindrical shape for loading.
3. Slide the bag into the gun to a position slightly below the gun opening so that the nozzle tip sticks out of the barrel. Tuck in any overlapping portions of the bag.



4. Start the tip of the nozzle through the hole in gun cap. Lock gun cap in place.
5. Pull nozzle until fins come completely through cap. Twist clockwise to lock nozzle to cap (fins engage cap ramps). Gun is now ready to use. No piercing tool required.

Injecting Resin Into a Splice

1. Lightly press the threaded tip of the nozzle into the P-1 Injection Fitting on the splice.
2. Rotate entire gun 3 or 4 turns (clockwise) to engage nozzle firmly and form a liquid-tight coupling.
3. Advance piston until resistance is felt. A slight extra pressure will cause the cutting edges of the nozzle to pierce the "Unipak" and permit resin to be pumped into the splice. The slotted piercing edges prevent blocking the flow of resin by tucks or folds in the bag material. Continue injecting resin until splice is full (drop-lets of resin appear at vent holes at the ends of the splice envelope).
4. To remove gun from splice, rotate *entire gun* counterclockwise to unscrew nozzle from fitting.

General Hints on Injecting Resin

1. To unload gun, unlock gun cap and remove. Nozzle and bag assembly can then be easily unlocked from cap and discarded.
2. When more than one "Unipak" is needed to fill a single splice, an assistant can prepare the next "Unipak" while the first is being injected.
3. Wiping accidental drips or spills while the resin is still liquid is the easiest cleanup method. Wash hands thoroughly with soap and water afterwards.
4. If hands are exceptionally dirty, it is helpful to place tape patch before mixing.

B. RESIN POURED INLINE SPLICE WITH IMPREGNATED CORE

1. Where generally used?
 - a. 89D series kits are chosen where cable size allows use of pre-formed molds and application permits horizontal positioning of joint.
2. Selection of "Scotchcast" Communications Kits
 - a. The first consideration is the outside diameter of the cable.
 - b. The second consideration is the maximum sheath opening. If this is too short for the particular cable, then a resin pressure splice should be used.

SPlicing DOUBLE SHEATH CABLE		
Kit No.	No. of Pairs	Maximum Sheath Opening
89D-1	1 to 4	6" (15.24 CM)
89D-2	5 to 13	9 1/2" (24.13 CM)
89D-3	14 to 26	14" (35.56 CM)

SPlicing SINGLE SHEATH CABLE		
Kit No.	No. of Pairs	Maximum Sheath Opening
89D-1	1 to 4	5" (12.7 CM)
89D-2	5 to 13	8" (20.32 CM)
89D-3	14 to 26	11" (27.94 CM)

*Graded Insulation of #19 AWG through #26 AWG. Maximum Insulated conductor diameter, .075 Inches using "Scotchlok" Brand Type UR Connector.

These kits include the split mold body, pouring spouts, resin end sealing tape and jumper wire and shielding clips.

3. Fitting and sealing the mold.
 - a. The mold is fitted to the cable by cutting the tapered notched ends to the desired dimensions. The mold halves snapped together over the splice, and the mold ends sealed the cable sheath with tape provided in kit. Install the pouring spouts into the mold body.
4. Mixing and Pouring the "Unipak" Container of Resin.
 - a. Mix the resin using the instructions in the "Unipak" Container.
 - b. Pour the resin through one spout only until both spouts are full. In some loose core cables, it may be necessary to re-pour the spout after a few minutes as resin seeps into the core.



C. CONSTRUCTION OF INLINE SPLICES WITH NON-IMPREGNATED OR OPEN CORE

1. Where generally used?

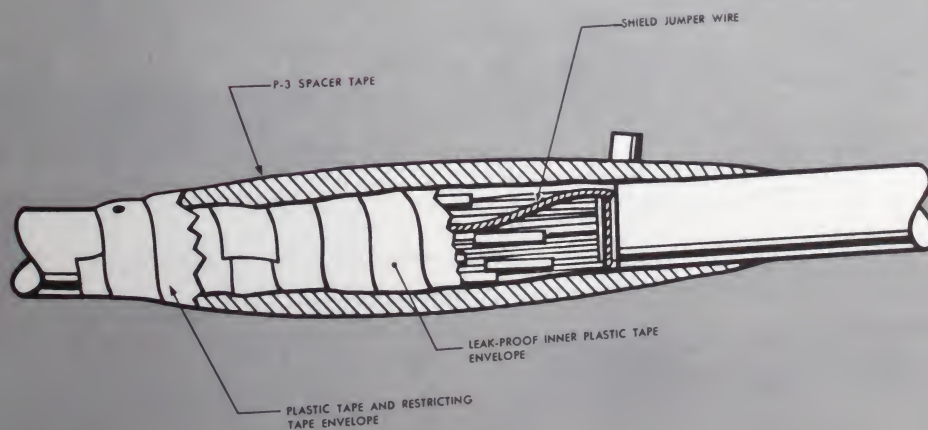
- The non-impregnated (or open-core splice) is used where gas pressure is to be passed through the splice, or re-opening of the splice may be necessary.

2. Resin Pressure method or poured method—with internal tape barrier

- This splice is built the same as the resin impregnated core splice except a half lapped layer of "Scotch" Brand 33 or 22 Tape is applied over the conductor bundles prior to pouring of resin or applying P-3 Spacer Tape. This prevents the resin from impregnating the conductors. A typical drawing appears below.
- The internal tape barrier is similarly applied when using 89-D Series Communication Kits. Complete instructions are included in the kits.

3. Lead sleeve method.

- In some applications, individuals desire to use a lead sleeve as the splice enclosure, but are confronted by obstacles in wiping a sleeve. Some might be: a location where heat is not permissible or the use of a plastic cable (PIC) does not allow wiping. Two small Resin Pressure seals are then made on the sleeve ends for bonding to the cable sheath. This is illustrated in the appendix on page 25.



D. END SEALING WITH 89-C SERIES Scotchcast BRAND KITS

1. Seals in Pedestal Terminations of Direct Burial Plants.

a. Where and why used?

1. With a buried cable not in ducts (direct burial), it is essential, at intervals, to bring the cable above ground into pedestal terminals or cabinets. Within these terminals, the cable sheath is opened and connections are made. An unsealed sheath is a possible entry point for moisture or a gas escape

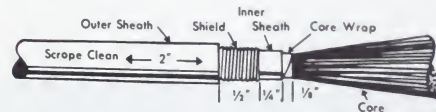
point in a pressurized system. The cable should be sealed at each end of the sheath and the conductors free in between to permit future work. In general, a sealed copper tube under the sheath is desirable. This allows for pressurizing the cable, checking pressures, or provides an easy point to inject gas for drying the cable in case of moisture in the cable.

END SEALING AND GAS BY-PASS FOR PLASTIC INSULATED (PIC) CABLE

Choose the following "Scotchcast" Brand 89C series End Sealing Kits for cable of 6 or more pairs.

KIT NO.	CABLE O.D.
89C-1	1/4" - 3/4" (6.35—19.1 mm)
89C-2	3/4" - 1 1/8" (19.1—36.5 mm)

Step 1. Prepare cable ends as shown below.



Step 2. CAUTION: DO NOT WIPE GREASE OFF VENT WIRE

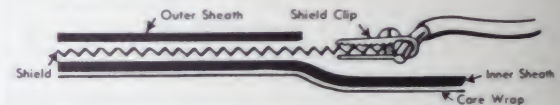
Slip a valve stem onto the curved vent wire. Insert the end of the vent wire between the inner sheath and core wrap. Push wire all the way in. (See cutaway view below.)



Curvature of vent wire prevents point from damaging core wrap or cable core



Step 3. Loosen screw on P-11 shielding clip and insert bare #14 solid conductor completely through the connector with a minimum of 1/16" wire shown on far side. Bend wire to desired shape. Push onto cable shielding and tighten screw.



Step 4. Trim ends of molded bodies to fit cable and snap into place. Use tape (provided) to seal mold to cable sheath. Note: Position mold body to catch approximately 1/2 inch of outer sheath.

Step 5. When both cable ends are fully prepared, mix the "Scotchcast" Brand Resin according to the instructions on the "Unipak" Brand Container.



Step 6. Pour half the resin into each mold. Allow to remain undisturbed until the resin has hardened and cooled. Hang the pouch containing connection fittings in the pedestal so it will be handy for final hookup.

Step 7. Final hookup after resin is fully set. (Parts in pouch previously hung in pedestal.)

- (a) Pull vent wires out of valve stems and discard. A 90° rotation to either side may be helpful.
- (b) Screw a valve core into each valve stem (use wrench cap provided).
- (c) Slip hose connectors into the ends of the by-pass hose. Screw connectors firmly onto valve stems to complete gas by-pass.

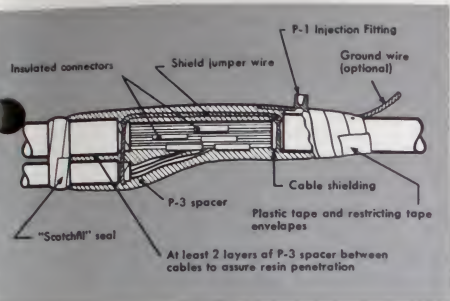
SPECIAL INSTRUCTIONS for pedestals containing 3 or 4 cable ends. Place additional equally spaced valve stem-vent wire assemblies in air supply cable end as follows:

- (a) For 3 cable end terminal, insert one additional stem in step 2.
- (b) For 4 cable end terminal, insert two additional stems in step 2.

NOTE: Watch spacing of additional stems to permit installation of hose connectors in final hookup.

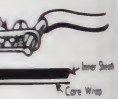
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vides an easy point to
ble in case of moisture

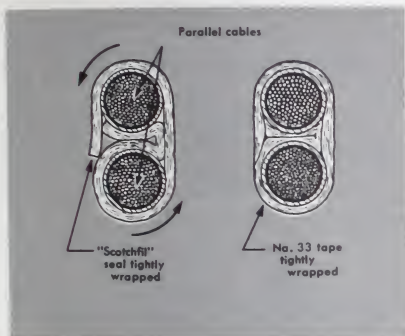


BLE

and insert bare fil solid
with a minimum of 1/16" wire
ve. Push onto cable shielding



able and snap into place. Use
Note: Position mold body to



Spread core to permit
good resin saturation



Parts in pouch previously

ms and discard. A 90° rotation

valve stem (use wrench cap

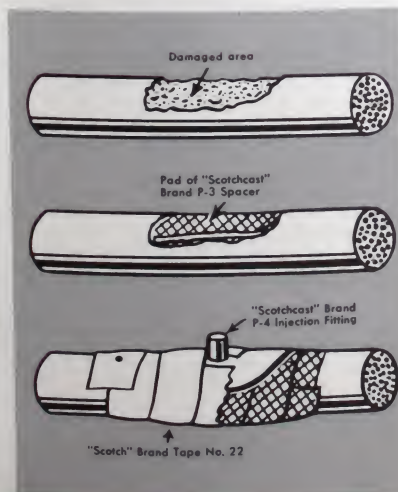
ends of the bypass hose
valve stems to complete gas

pedestals containing 3 or 4
d valve stem-wire assem-

additional stem in step 2

additional stems in step 2

to permit installation of hose



E. TAP (OR BRANCH) SPLICES

1. Resin Pressure Method with "Scotchfil" Dam and Impregnated core.
 - a. This technique uses a simple construction which permits handling the splice similar to an inline splice.
 - b. The tap cable is sealed to the run cable at the end of the splice as shown in figure at left.
 - c. After this seal is applied the splice is completed as an inline splice.

2. Resin Tap Splices with Open or Partially Open Core.

- a. Completely open core splices.

1. This splice is constructed in the same manner as the open core inline splice with the addition of two "Scotchfil" dams. Refer to appendix, page 26, for details.

- b. "Run" cable open and tap cable saturated.

1. Splices of this construction are most often used in a pressurized system. It is then possible to allow gas to continue in the run cable, but to be blocked in the tap cable stub.

2. The construction is shown in the appendix, page 27.

F. TRANSITION SPLICE FROM PAPER-LEAD TO PLASTIC

1. The inherent properties of "Scotchcast" Brand Resin #12 permit its use on a wide range of cable materials with no special precautions.
2. Since plastic insulated cable (PIC) is better able to operate in the presence of moisture than paper cable, a fully resin saturated splice is generally used. This prevents moisture from migrating from the plastic insulated cable into the paper insulated cable.

G. SHEATH REPAIR

The resin pressure technique is useful in repairing damaged cable sheath. If the damaged sheath has a section torn out, as shown, it can be repaired in the following manner:

STEP 1

Thoroughly clean the sheath around the damaged area to insure resin adhesion.

STEP 2

Form a pad of P-3 spacer tape to neatly fit in the damaged area.

STEP 3

Locate the P-1 injection fitting, apply the No. 22 plastic tape envelope, P-4 Restricting Tape, pierce vent holes and inject resin No. 12 as described previously.

GAS BLOCKING (or Core Dam) in COMMUNICATION CABLES

A. REASONS FOR PRESSURIZING CABLES

1. To understand why cables should be pressurized, one must first admit that man-made items are not perfect. Absolutely pin-hole free cables are not yet an item of commerce. Accepting this condition, the possibility of moisture entry exists throughout the length of the cable. As atmospheric pressures change, air will tend to migrate into or out of the cable through pin-holes or other defects. This is often referred to as "cable breathing." The entry of moist air or condensed water droplets causes considerable trouble in cable.
2. By pumping clean, dry air at about 10 psi (pounds per square inch) into the cable, one can be assured that the dry air will leak out rather than moist air enter the cable. Further, by measuring the quantity of air used in a cable, one can automatically determine the general condition of the cable. A sudden increase in air consumption indicates that a fault has developed. Unless it is very serious the air will keep moisture from doing further damage until a repair can be conveniently scheduled.
3. This continuous check permits planned work schedules for "off peak" work loads. By installing pressure test locations at intervals along a pressurized cable, one can, by use of a pressure gauge, localize the trouble spots in a cable.
4. While early attempts at pressurization used the optimistic approach of filling the cable with a dry gas and then only refilling periodically, most of the newly installed systems have a continuous supply of dry gas supplied to the cable. This dry gas is supplied from tanks or special dry air compressors at approximately eight to twelve psi.
5. In order to keep the gas consumption at a minimum and to transmit the pressure over long distances, the ends of the cable must be blocked. There are also places where a run of cables is to be blocked in the middle to properly sectionalize and control a complex cable system. The following discussion will describe how to make these blocks in various sizes and types of cables while in operation.

B. GAS BLOCK METHODS AND RESIN SELECTOR GUIDE

1. All the following methods use resins supplied in the "Unipak" Container along with other standard "Scotchcast" resin supplies. Two types of resin are available, "Scotchcast" No. 11 and No. 12.

Resin and Method Selector Guide

Outside Diameter of Cable	Insulation on Individual Conductors	"Scotchcast" Resin to be used	Method Used
0 to 1"	Paper or Pulp	11	2
	Plastic	12	2 or 3
1" & Up	Paper or Pulp	11	1
	Plastic	12	1

METHOD 1

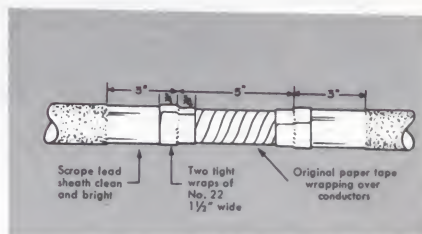
This method of gas blocking relies on the Resin being forced into a built up mold with a pressure gun and works with reliability whether the sheath be lead, plastic, rubber, or other material. For paper or pulp insulated cables use "Scotchcast" No. 11 Resin, for plastic insulated cables use "Scotchcast" No. 12 Resin.

A. For Cables Larger Than 1" O.D.

1. Sheath Opening

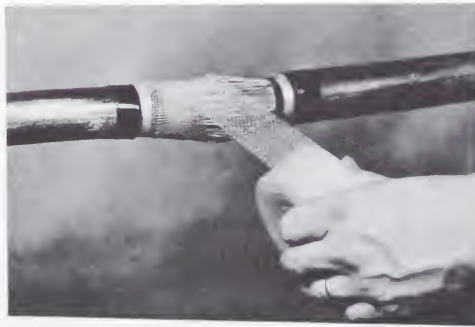
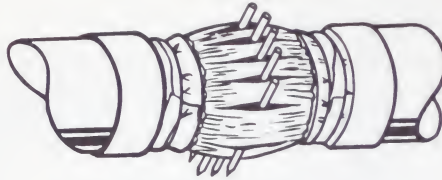
- a. Remove a 5" section of the sheath at the point where a gas block is desired.
- b. Clean sheath at least 3" on both sides of opening with a scraper or file card.
- c. Wrap 2 turns of 1½" wide "Scotch" Brand Electrical Tape No. 22 around sheath ends at both sides of the opening. Lap ½ tape width on sheath and ½ tape width on the wrapping that covers the conductor bundle.
- d. Immediately inside sheath opening and on top of the No. 22 Tape, apply at least 6 turns of "Scotch" Brand Filament Tape No. 45, ¼" wide. These turns must be stretched as tightly as possible, since they form constricting bands and prevent escape of resin down the cable.
- e. Remove original core wrapping between the two individual servings of No. 22 Tape. This will expose the conductor bundles. Carefully cut and remove cord bundle ties, including those on inside bundles. A common crochet hook sharpened on the interior surface is a handy tool for cutting inside bundle ties.

NOTE: With very large or complex cable it may be necessary to open the sheath more than 5". We have found that it is sometimes impossible to remove paper bundle ties and wrappings without extending the sheath opening. This is a matter of personal judgment on the part of the individual doing the job but additional information can be made available.



2. Preparation of the Block

Move the sheath ends back and forth to loose the compactness of the conductor bundles. If available, a cable jack or slack puller may be used.



- a. Insert "Scotchcast" P-9 Cable Channeling Pins through the conductor bundle. Pins are spaced parallel to each other and $\frac{1}{4}$ " to $\frac{3}{8}$ " apart. They are spaced in a straight line across the center of the cable opening like the teeth of a comb. A pin chuck, tap wrench, or similar tool is generally necessary for holding pins during insertion. Use a pushing and twisting action. CHANNELING PINS ARE NOT REQUIRED FOR CABLE HAVING PLASTIC INSULATED CONDUCTORS. *NOTE:* The channeling pins form open paths in the conductor bundle. The resin will follow these channels, permitting complete saturation of the entire bundle. The pins are made of an excellent insulating material. Accidental scuffing of the insulation as the pin is inserted will not result in lost pairs, since the insulating pin remains in place and the resin reinsulates. DO NOT attempt to *drive* the pins through the bundles like nails. Working them through with a pushing, twisting motion will avoid any cable damage. Cut off excess length of pins.
- b. Wrap opening with P-3 Spacer Tape to $\frac{3}{16}$ " minimum thickness.
- c. Place P-1 Injection Fitting over ends of pins. Apply a liquid-tight envelope of $1\frac{1}{2}$ " wide "Scotch" No. 22 Tape.
- d. Wrap the block with P-4 restricting tape, starting at one end and using a long spiral wrap. Be sure the entire area is covered with a minimum of two layers applied as tightly and conformably as possible. This is important since high pressure must be contained. Apply two tight constricting bands of "Scotch" Filament Tape No. 45, $\frac{1}{4}$ " wide at the ends.



3. Injecting Resin Nos. 11 and 12

Slowly inject the correct "Scotchcast" Resin, using the E-4 Resin Pressure Gun. Maintain pressure for 3 to 5 minutes longer to allow paper insulation to absorb resin. Pressure developed in this type block is quite high. See page 12 for details on preparing the "Unipak" and on loading and using the Resin Pressure Gun.

IMPORTANT: This method works with maximum reliability on cables larger than 1" O.D. Certain simplifications described in the next section are possible on cables 1" O.D. or smaller. The user is urged to test any simplifications thoroughly, or write for specific recommendations on his problems.

MATERIAL QUANTITIES						
Cable OD In Inches	P-1 each	P-3 Rls.	P-4 Rls.	P-5 Rls.	No. 22(1½") Feet	Unipaks B C
1 to 1½	1	1	1	1	12	1
1½ to 2	1	1½	1½	1	18	2
2 to 3	1	2	2	1	24	1

METHOD 2

For cables with an O.D. of 1" or smaller, either plastic or paper insulated; for paper or pulp use "Scotchcast" No. 11; for plastic use "Scotchcast" No. 12.

1. Drill or cut approximately ¼" hole in sheath. Scrape sheath to clean thoroughly.
2. Remove binder wrap and shielding so individual conductor insulation is exposed.
3. Place P-1 Injection Fitting over ¼" hole. The diameter of the P-1 Fitting may be cut down to fit smaller cables. Apply one layer of half lapped "Scotch" Brand No. 22 Tape, 1½" wide, 3" on each side of the injection fitting.
4. Apply two half lapped layers of P-4 Restricting tape, completely covering the No. 22 tape.
5. For information on mixing the "Unipak" container and on loading the resin pressure gun see page 12.
6. Inject Resin slowly, using either the E-4 or E-12 Resin Pressure Gun. Maintain pressure for 3 to 5 minutes, minimum.





METHOD 3

THE 89 D SERIES KIT METHOD FOR PLASTIC COMMUNICATION CABLE 1" DIAMETER AND SMALLER

This method of gas blocking relies on pouring Resin No. 12 into ready-to-use plastic molds that have been snapped over the opened sheath and is to be used only with plastic conductor insulation and a cable O.D. of 1 inch or less.

1. Open the sheath at the point where a block is desired (the opening should be large enough to allow for convenient working space but short enough to be covered by the mold size selected).
2. Expose the conductors and work the cable to separate the individual conductors.
3. If desired, continue earth continuity across sheath opening with the jumper wire and shielding clips provided in the kits.

NOTE: 89D Series Communications Kits will accept cable sizes as shown below:

Kit No.	No. of Pairs	Maximum Sheath Opening
89D-1	1 to 4	5" (127mm)
89D-2	5 to 13	7" (178mm)
89D-3	14 to 26	10" (254mm)

4. Place the mold body around the sheath over the opening and snap the mold halves together.

5. Tape the ends of the mold to prevent leakage and insert the plastic pour spouts in the holes at the top of the mold.
6. Prepare the "Unipak" by breaking the divider seal and mix as stated on instructions included in package.
7. Then a corner of the "Unipak" is cut off and the resin is poured into the mold as shown.

R PLASTIC
AND SMALLER

Resin No. 12 into
d over the opened
tor insulation and

desired (the open-
venient working
hold size selected).
separate the indi-

each opening with
in the kits.
accept cable sizes

Maximum
Sheath Opening

5" (127mm)

7" (178mm)

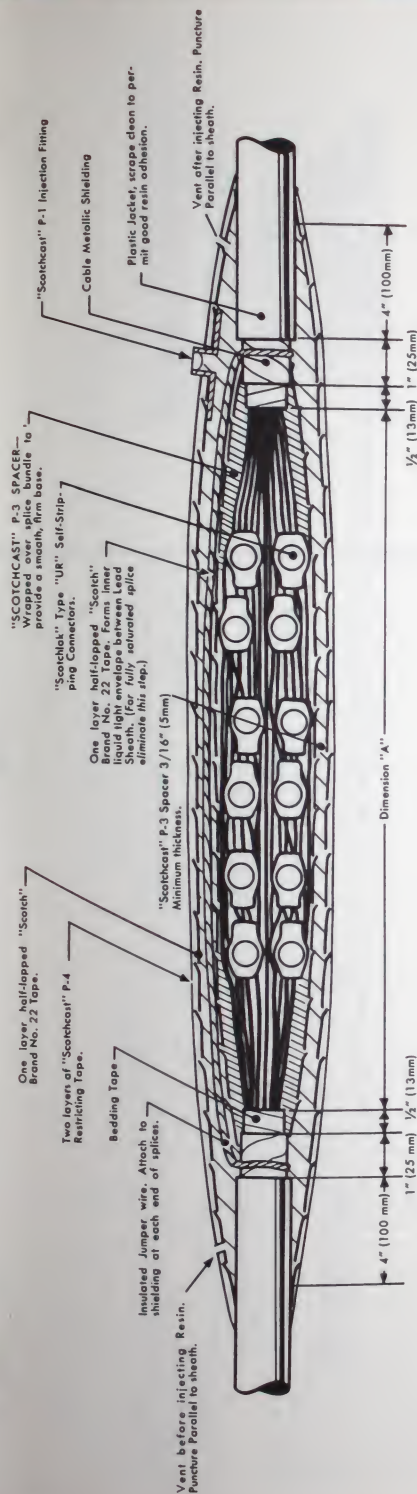
10" (254mm)

the opening and

e and insert the
the mold.

seal and mix as

e resin is poured



MATERIALS REQUIRED FOR A COMPLETELY SATURATED SPLICE

APPROXIMATE O.D. OF CABLE Inches	Dimension "A" Inches	Dimension "A" Millimeters	P-3 Spacer Rolls	No. 22 Tape Feet	P-4 Restricting Tape Rolls	P-1 Filling Nozzle	"UNIPAKS"		
							A	B	C
.5 to .75	13 to 19	10	230	7	1/2	1	2	1	1
.75 to 1.0	19 to 25	12	300	10	1	1	2	1	1
1.0 to 1.5	25 to 38	14	350	2	1 1/2	1	2	2	2
1.5 to 2.0	38 to 50	16	400	3	2	1	4	1	3
2.0 to 2.75	50 to 63	20	500	32	3	1	7	7	7
2.75 to 3.0	63 to 75	24	600	43	4	1	11	1	10

NOTE: Amount of material specified herein are to facilitate ordering. They are based on average quantities used by a good workman, plus a safety factor.

MATERIALS REQUIRED FOR A NON-SATURATED SPLICE

APPROXIMATE O.D. OF CABLE Inches	Dimension "A" Inches	Dimension "A" Millimeters	P-3 Spacer Rolls	No. 22 Tape Feet	P-4 Restricting Tape Rolls	P-1 Filling Nozzle	"UNIPAKS"		
							A	B	C
.5 to .75	13 to 19	10	250	1	1/2	1	1	1	1
.75 to 1.0	19 to 25	12	300	1 1/2	1	1	1	1	1
1.0 to 1.5	25 to 38	14	350	2	1 1/2	1	1	1	1
1.5 to 2.0	38 to 50	16	400	3	2	1	2	1	1
2.0 to 2.75	50 to 63	20	500	53	3	1	3	1	2
2.75 to 3.0	63 to 75	24	600	72	4	1	3	1	3

NOTE: Amount of material specified herein are to facilitate ordering. They are based on average quantities used by a good workman, plus a safety factor.

**"SCOTCHCAST" BRAND
RESIN PRESSURE
METHOD FOR INLINE
SPlicing OF PLASTIC
COMMUNICATION CABLES**



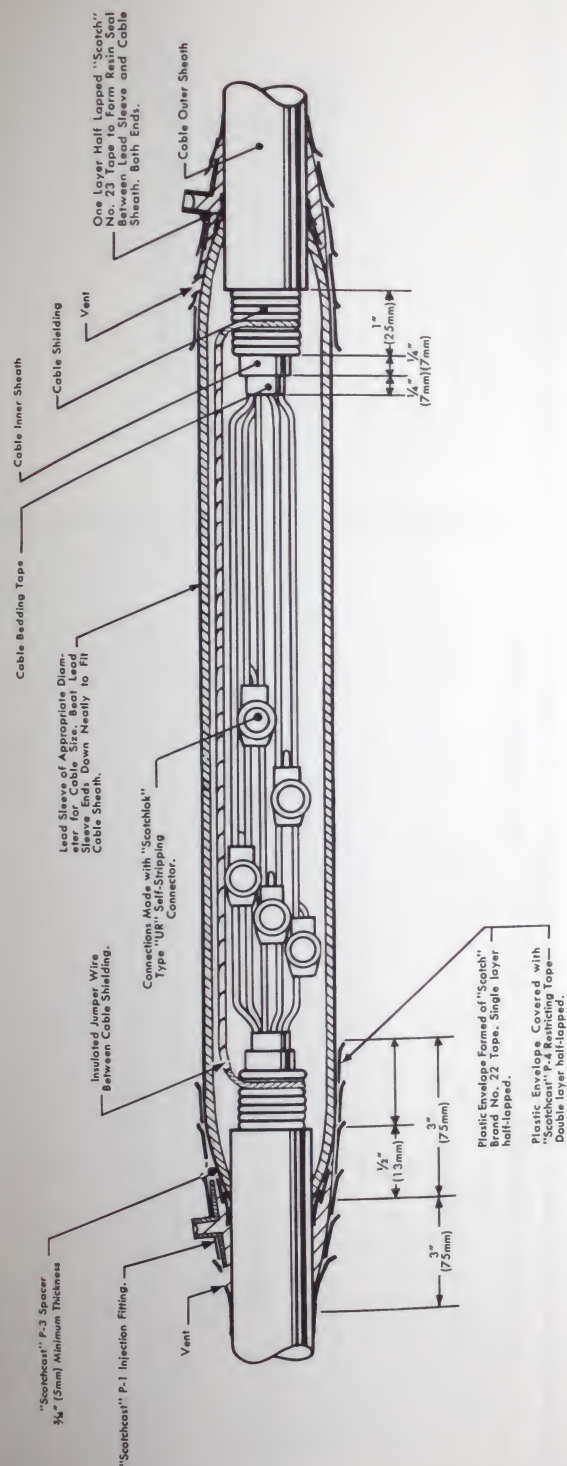
**"SCOTCHCAST" BRAND
RESIN PRESSURE
INLINE SPLICE
FOR LEAD-PAPER
COMMUNICATION CABLES**

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by a good workman, plus a safety factor.

APPROXIMATE O.D. OF CABLE			Dimension "A"		P-3 Spacer Rolls	No. 22 Tape Feet	P-4 Restricting Tape Rolls	P-1 Filing	P-5 Nozzle	"UNIPAKS"		
Inches	Millimeters	Inches	Millimeters	A						B	C	
.5 to .75	13 to 19	10	250	1	10½	½	1	1			1	
.75 to 1.0	19 to 25	12	300	1½	15	1	1	1				1
1.0 to 1.5	25 to 38	14	350	2	23	1½	1	1				1
1.5 to 2.0	38 to 50	16	400	3	33	2	1	2			1	1
2.0 to 2.75	50 to 63	20	500	4½	53	3	1	3			1	2
2.75 to 3.0	63 to 75	24	600	6	72	4	1	3				3

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by a good workman, plus a safety factor.

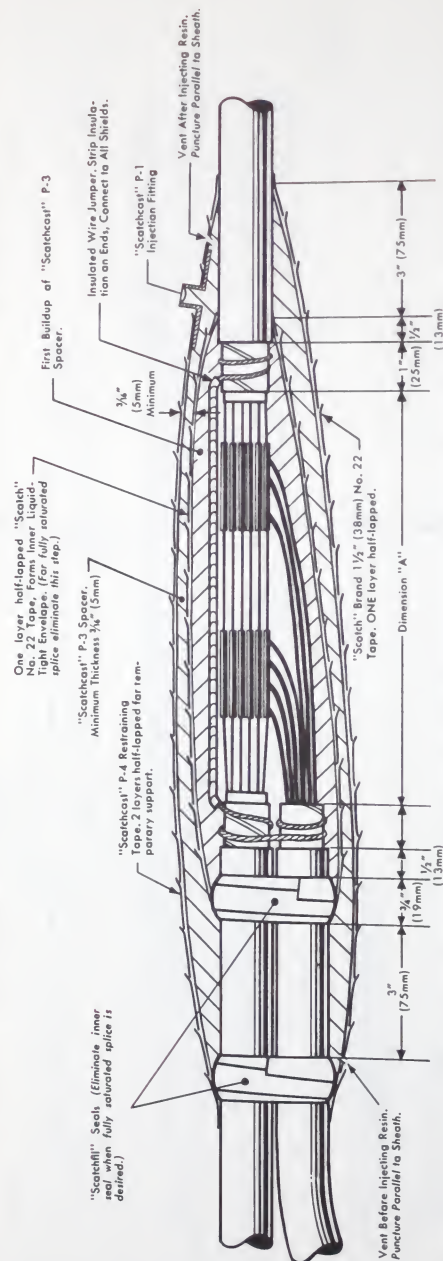
	0	1	2	3	4	5	6	7	8	9	Total
.75 to 1.0	19	25	12	300	1	15					1
1.0 to 1.5	25	to 38	14	350	2	1	1½				1
1.5 to 2.0	38	to 50	16	400	3	2	1	2			1
2.0 to 2.75	50	to 63	20	500	4½	53	3	1	3		2
2.75 to 3.0	63	to 75	24	600	6	72	4	1	3		3



MATERIALS REQUIRED

APPROXIMATE O.D. OF CABLE		P-3 Spacer Rolls	No. 22 Type Feet	P-4 Restricting Type Rolls	P-1 Injection Fitting	P-5 Nozzle	"UNIPAKS"		
Inches	Millimeters						A	B	C
.5 to .75	13 to 19	1/2	6	1/4	2	1			
.75 to 1.0	19 to 25	3/4	7	1/2	2	1	1		
1.0 to 1.5	25 to 38	1	9	3/4	2	1	1/2		
1.5 to 2.0	38 to 50	1	11	1	2	1	1		
2.0 to 2.75	50 to 63	1 1/2	15	1 1/4	2	1	1		
2.75 to 3.0	63 to 75	1 1/2	17	1 1/2	2	1			1

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by a good workman, plus a safety factor.



MATERIALS REQUIRED FOR A COMPLETELY SATURATED SPLICE

APPROXIMATE O.D. OF CABLE	Dimension "A"		P-3 Spacer Rolls	No. 22 Tape Feet	P-4 Restricting Tape Rolls	P-1 Fitting	P-5 Nozzle	"UNIPAKS"		
	Inches	Millimeters						A	B	C
.5 to .75	13 to 19	10	1	7	1/2	1	2	1	1	1
.75 to 1.0	19 to 25	12	1 1/2	10	1	1	2	1	1	2
1.0 to 1.5	25 to 38	14	2	15	1 1/2	1	2	1	1	3
1.5 to 2.0	38 to 50	16	3	21	2	1	4	1	1	7
2.0 to 2.75	50 to 63	20	4 1/2	32	3	1	7	1	1	10
2.75 to 3.0	63 to 75	24	6	43	4	1	11	1	1	10

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by a good workman, plus a safety factor.

MATERIALS REQUIRED FOR A NON-SATURATED SPLICE

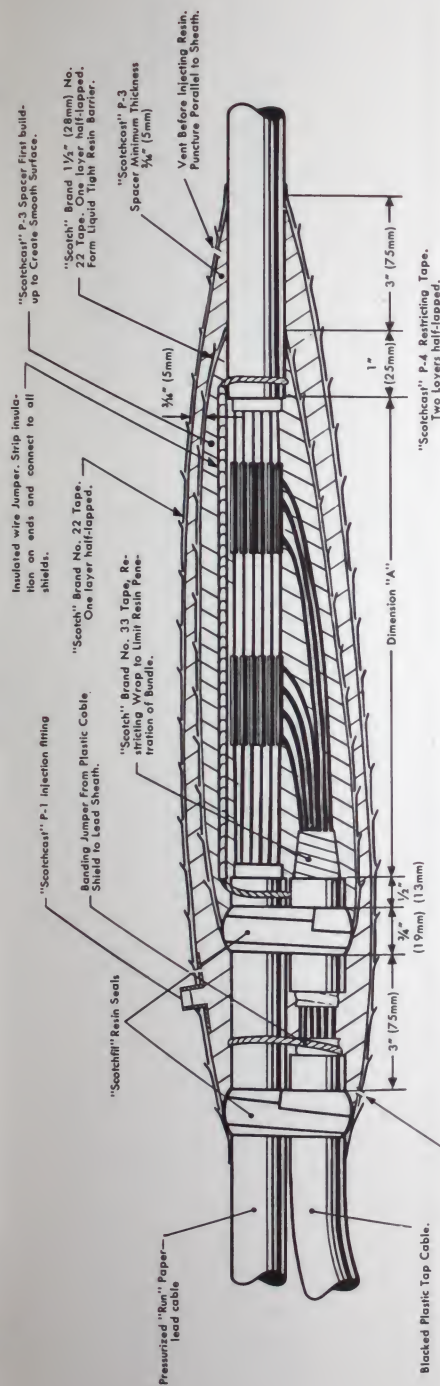
APPROXIMATE O.D. OF CABLE	Dimension "A"		P-3 Spacer Rolls	No. 22 Tape Feet	P-4 Restricting Tape Rolls	P-1 Fitting	P-5 Nozzle	"UNIPAKS"		
	Inches	Millimeters						A	B	C
.5 to .75	13 to 19	10	1	10	1/2	1	1	1	1	1
.75 to 1.0	19 to 25	12	1 1/2	15	1	1	1	1	1	1
1.0 to 1.5	25 to 38	14	2	23	1 1/2	1	1	1	1	1
1.5 to 2.0	38 to 50	16	3	33	2	2	2	1	1	1
2.0 to 2.75	50 to 63	20	4 1/2	53	3	1	3	1	1	2
2.75 to 3.0	63 to 75	24	6	72	4	1	3	1	1	3

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by a good workman, plus a safety factor.

**"SCOTCHCAST" BRAND
RESIN PRESSURE
TAP SPLICE ON
COMMUNICATIONS CABLE**

Number of plants	Number of leaves	Number of flowers	Number of fruits	Number of seeds	Number of plants	Number of leaves	Number of flowers	Number of fruits	Number of seeds
1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4
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98	98	98	98	98	98	98	98	98	98
99	99	99	99	99	99	99	99	99	99
100	100	100	100	100	100	100	100	100	100

10



"Scotchcast" P-3 Spacer First build-up to Create Smooth Surface

"Scotch" Brand 1 1/2" (28mm) No. 22 Tape. One layer half-lapped. Form Liquid Tight Resin Barrier.

"Scotchcast" P-3
 per Minimum Thickness
 36.0" (5mm)

"Scotch" Brand No. 22 Tape.
One layer half-lapped.

Banding Jumper From Plastic Cable Shield to Lead Sheath.

"Scotchfil" Resin Seals

"Scotch" Brand No. 33 Tape, Restricting Wrap to Limit Resin Penetration

Pressurized "Run" Po
lead cable

Blacked Plastic Tap Cable:

Remove 1/2" Section of Plastic Cable Shield to Permit Resin Blocking of Core. On Plastic "Tap", Cable ONLY.

Vent After Injecting Resin.
Puncture Parallel to Sheath.

MATERIALS REQUIRED PER SPLICE

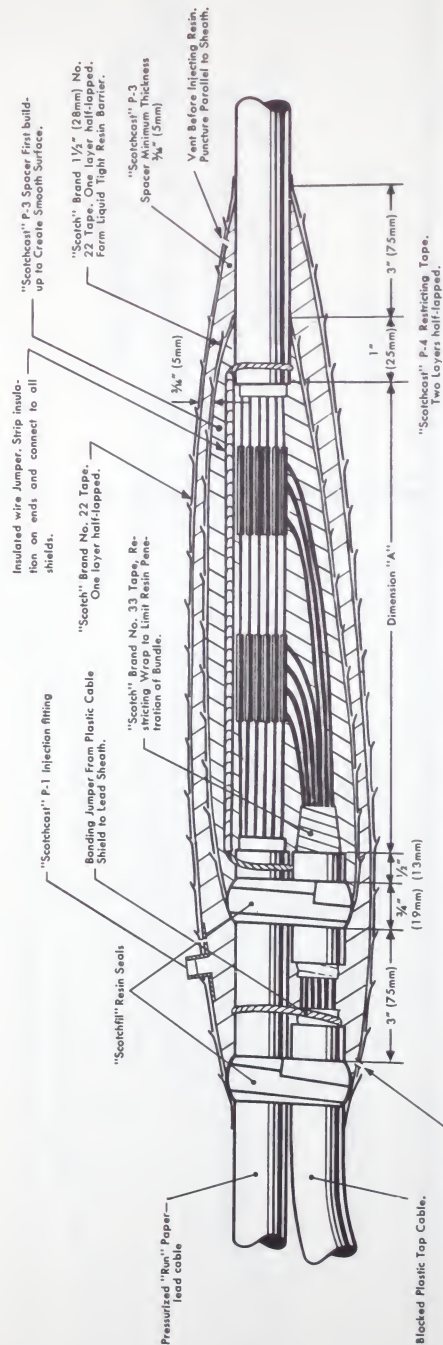
APPROXIMATE O.D. OF CABLE		Dimension "A"		P-3 Spacer Rolls	No. 22 Tape Feet	P-4 Restricting Tape Rolls	P-1 Fitting	P-5 Nozzle	"UNIPAKS"		
Inches	Millimeters	Inches	Millimeters						A	B	C
.5 to .75	13 to 19	10	250	1	10	1/2	1	1		1	
.75 to 1.0	19 to 25	12	300	1 1/2	15	1	1	1			1
1.0 to 1.5	25 to 38	14	350	2	23	1 1/2	1	1			1
1.5 to 2.0	38 to 50	16	400	3	33	2	1	2	1	1	1
2.0 to 2.75	50 to 63	20	500	4 1/2	53	3	1	3		1	2
2.75 to 3.0	63 to 75	24	600	6	72	4	1	3			3

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by a good workman, plus a safety factor.

**"SCOTCHCAST" BRAND
RESIN PRESSURE
TAP SPLICE ON OPEN RUN CABLE
AND BLOCKED TAP CABLE**

RESIN PRESSURE

TAP SPLICE ON OPEN RUN CABLE AND BLOCKED TAP CABLE



Remove 1/2" Section of Plastic Cable Shield to Permit Resin Blocking of Core, On Plastic "Tap" Cable ONLY.

Vent After Injecting Resin, Puncture Parallel to Sheath.

"Scotchcast" P-4 Restricting Tape, Two layers half-lapped.

MATERIALS REQUIRED PER SPLICE

APPROXIMATE O.D. OF CABLE	Inches	Millimeters	Dimension "A"	P-3 Spacer Rolls	No. 22 Tape Feet	P-4 Restricting Tape Rolls	P-1 Fitting	P-5 Nozzle	"UNIPAKS"		
									A	B	C
.5 to .75	13 to 19	10	250	1	10	1/2	1	1		1	
.75 to 1.0	19 to 25	12	300	1 1/2	15	1	1	1			1
1.0 to 1.5	25 to 38	14	350	2	23	1 1/2	1	1			1
1.5 to 2.0	38 to 50	16	400	3	33	2	1	2		1	1
2.0 to 2.75	50 to 63	20	500	4 1/2	53	3	1	3		1	2
2.75 to 3.0	63 to 75	24	600	6	72	4	1	3			3

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by a good workman, plus a safety factor.

"SCOTCHCAST" BRAND RESIN PRESSURE TAP SPLICE ON OPEN RUN CABLE AND BLOCKED TAP CABLE

NOTE: Amounts of material specified herein are to facilitate ordering. They are based on average quantities used by a good workman, plus a safety factor.

For further information on these products contact:

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Sydney, NSW., Australia
Minnesota "3M" Technische
Vertriebsgesellschaft mbH.,
Auerspergstrasse 17,
P.O. Box 99
Vienna 64, Austria
Minnesota Mining and Manufacturing
(Belgium) S.A.,
36 rue Demosthene,
Anderlecht,
Brussels 7, Belgium
Minnesota Manufactureira e Mercantil Ltd.
Rua Augusta 1771-20.
Conj. Nacional 29
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Sao Paulo, Brazil
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Copenhagen, SV, Denmark
Minnesota Mining & Manufacturing
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Santurce, Puerto Rico
Minnesota Mining & Mfg. Company
(South Africa) (Pty) Ltd.,
Lower Germiston Road
Heriotdale
P.O. Box 10465
Johannesburg, Republic of South Africa
Minnesota Mining & Mfg. Co. (Central
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Salisbury Street 12-A
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Salisbury, Central African Federation
Minnesota de Espana S.A.
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Stockholm Va, Sweden
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P.O. Box 2083
Caracas, Venezuela

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Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his intended use, and user assumes all risk and liability whatsoever in connection therewith. No statement or recommendation not contained herein shall have any force or effect unless in an agreement signed by officers of seller and manufacturer.

"SCOTCH", "SCOTCHRAP", "IRVINGTON", "SCOTCHLOK", "SCOTCHCAST"
and "UNIPAK" ARE REGISTERED TRADEMARKS OF 3M COMPANY

International Division **3M**
COMPANY

BOX 3800, ST. PAUL 1, MINNESOTA, U.S.A.

Scotchlok[®]
BRAND

COMMUNICATION CONNECTORS



TYPE UG

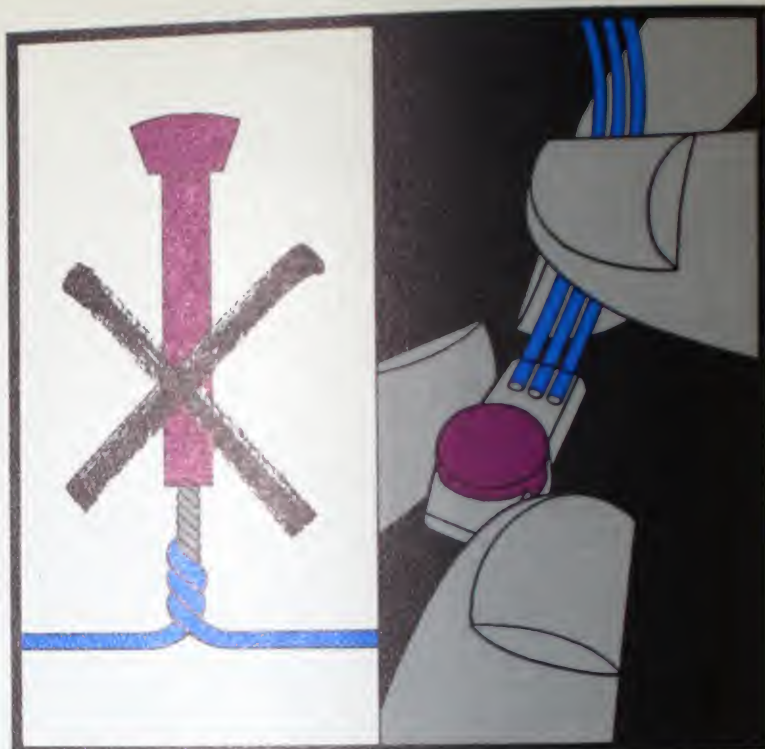


TYPE UR



TYPES U1R, U1B, U1Y

EASY, DEPENDABLE
COMMUNICATION
SPLICING
with
"U-ELEMENT",
PRE-INSULATED,
SELF-STRIPPING



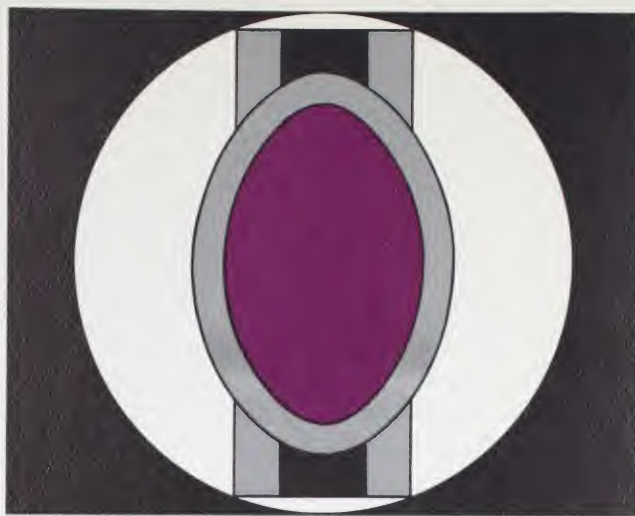
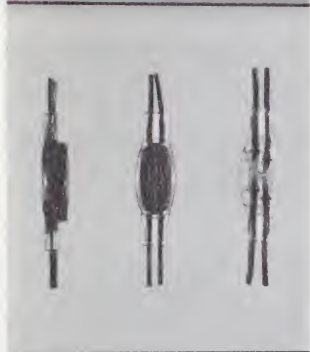
"SCOTCHLOK" BRAND
COMMUNICATIONS CONNECTORS

Designed to replace twist and solder joining, "SCOTCHLOK" Communications Connectors combine unique capabilities to accept broad ranges of wire sizes with the "live spring" holding power of the "U-Element." The broad wire range results primarily from the assignment of a separate connective element to each conductor and interconnecting these elements with a conductive bus bar.

The "live spring" joint is made, as depicted on the left, by compressing the connecting element portion of the connector into the sleeve. When the element is pressed into the sleeve, the connecting element contacts the insulation, shears it away from the conductor, grasps the conductor, and holds the conductor with a firm, resilient pressure. The result is a firm, gastight connection, equivalent to the finest twist and solder joint.

General characteristics of "SCOTCHLOK" Communications Connectors are as follows:

- Self-Stripping — The "U-Element" removes insulation as it enters the sleeve to save time and prevent conductor nicking by eliminating the stripping operation.
- Uniform — Conductor-conductor contact area, a minimum of 2.5 times the conductor cross section, insures uniform, dependable service.
- Corrosion Resistant — All connections made with "SCOTCHLOK" Connectors are sealed with a special sealant — prevents connection corrosion.
- Pre-Insulated — The "U-Element" is encased in a plastic sleeve so the insulation is on before the connection is made.
- Visual Inspection — The transparent sleeves on all connectors let you see the connections.
- Dependability — Consistent, positive splice in the field under all conditions. Hundreds of millions of "U-Element" connectors are now in service.
- Secure — Connections can't work loose, sleeve can't slip, solder can't be cold. Eliminates future circuit interruptions and time consuming troubleshooting.
- Simple, fast, labor-saving connections. Complete connection in less than the time it takes to make an unsoldered twist and sleeve joint.



"SCOTCHLOK" BRAND TYPE U1R, U1B AND U1Y CONNECTORS

A "U-Element" connector featuring parallel "U-Elements" for full pair inline splicing. Each connector makes, insulates, moisture and corrosion seals a full pair in just three (3) steps: Cut wire to length, insert into connector and crimp. No stripping, twisting, soldering or insulating is necessary.

Use the Type U1R Connector for inline splicing full pairs of wire in distribution cable or steel core drop wire where anticipated tensile load is less than 100 lbs. The Type U1R Connector makes, insulates and moisture seals full pairs of No. 19 through No. 24 AWG solid or No. 19 through No. 22 AWG stranded wire with a maximum insulation O.D. of .125 inches. It is compatible with all known conductor insulations. Its characteristics include self-stripping, uniform contact area, corrosion resistance, pre-insulated, visual inspection, dependable, and secure and easy.

The Type U1B Connector is identical to the Type U1R Connector described above except for a slight increase in the size of the "U-Element" slot to permit accommodation of larger wire sizes.

Use the Type U1B Connector for inline splicing full pairs of wire in distribution cable or steel core drop wire where anticipated tensile load is less than 100 lbs. The Type U1B Connector makes, insulates and moisture seals full pairs of No. 16 through No. 19 solid or stranded wire with a maximum insulation O.D. of .125 inches. It is compatible with all known cable insulation. Its characteristics include self-stripping, uniform contact area, corrosion resistant, pre-insulated, visual inspection, dependability, security and ease of installation.

The Type U1Y Connector is a four-way tap (bridge) connector designed to simplify cutting in service on rural distribution or control cable. Utilizing the "U-Element" Connecting Principle, with a shorting bar between the two elements, the Type U1Y Connector makes the trunk line splice and one or two service splices in one quick step.

Use the Type U1Y Connector for three or four-way tap (bridge) splicing on distribution cable or steel core drop wire where anticipated tensile load is less than 100 lbs. The Type U1Y Connector makes, insulates and moisture seals three or four-way tap joints on No. 16 through No. 19 solid or stranded wire with a maximum insulation O.D. of .125 inches. It is compatible with all known cable insulations.



"SCOTCHLOK" Communications connectors provide a broad range of wire combinations and wire sizes. The broad range of separate connective elements with a con-

nectivity is achieved by compressing the sleeve. When the electrical contacts the insulator, and holds the wires in a firm, gastight connection.

Scotchlok Connectors are

as it enters the sleeve the stripping operation is a minimum of 2.5 seconds of dependable service. ■

"SCOTCHLOK" Connectors are corrosion resistant. ■ Prevents so the insulation is not damaged. ■ The transparent

■ Dependability — Thousands of miles. Hundreds of miles. Secure — Connections eliminate future circuit

Simple, fast, labor-saving. It takes time to make



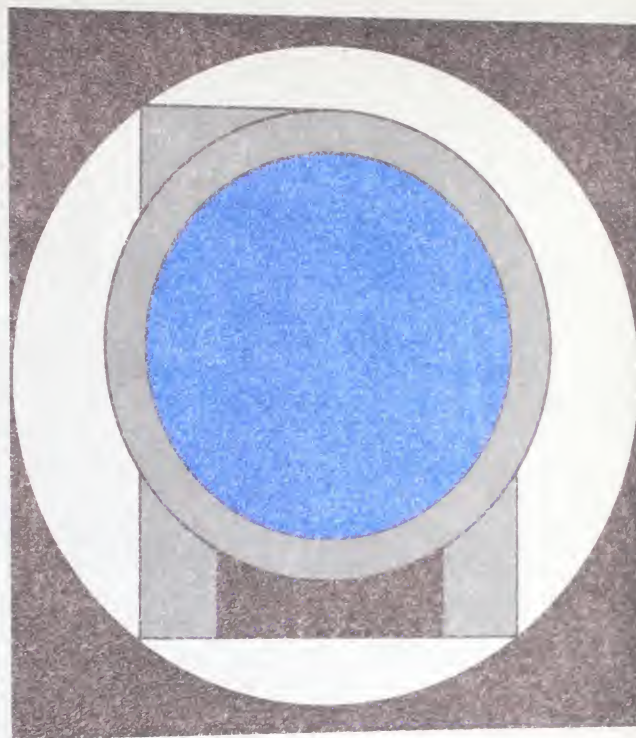
"SCOTCHLOK" BRAND TYPE UR CONNECTOR

The first practical communications connectors are transparent pigtail type "U-Element" connectors. They feature installation speed and simplicity, coupled with unmatched dependability to reduce installation time and reduce service outages. Each connector is filled with a grease type sealant to prevent moisture problems in the joint area.

Use the Type UR Connector for cutting in service in ready access cases, pedestal mounts and for pigtail joints on cable splices. The Type UR Connector makes, insulates and moisture seals any two or three wire combinations of No. 19 through No. 26 AWG solid or No. 20 through No. 24 AWG stranded wire, with a maximum insulation O.D. of .068 inches. Compatible with all known conductor insulations.

Its characteristics include:

SELF-STRIPPING + UNIFORM CONTACT AREA + CORROSION
RESISTANT + PRE-INSULATED + VISUAL INSPECTION + DEPEND-
ABILITY + SECURITY



FLAT CABLE SYSTEM

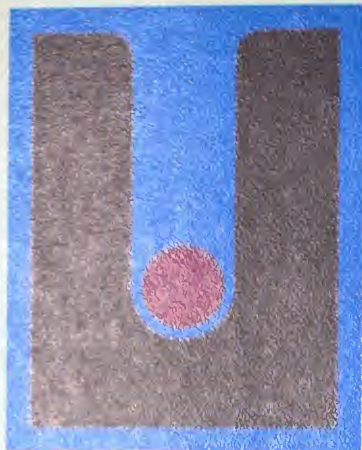
"SCOTCHLOK" BRAND TYPE UG CONNECTOR

A "U-Element" connector incorporating a unique snap-on side slot that facilitates quick, easy and reliable bridge joints without interrupting down stream service. Requires only the amount of cable slack necessary to free the most central pair and is filled with a grease type sealant to prevent corrosion problems in the joint area.

Use the Type UG Connector for cutting in service (without interrupting down stream service) in ready access cases, pedestal mounts or service shafts in multi-story buildings; for cutting in loading coils and for bridge joints on cable taps. The Type UG Connector makes and insulates any two wire combinations of No. 19 through No. 26 AWG solid or No. 20 through No. 24 AWG stranded wire with a maximum insulation O.D. of .068 inches. It is compatible with all known conductor insulations.

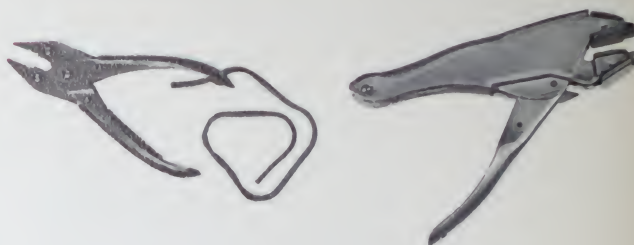
Its characteristics are:

SELF-STRIPPING + UNIFORM CONTACT AREA +
CORROSION RESISTANT + PRE-INSULATED + VISUAL
INSPECTION + DEPENDABLE + SECURE AND EASY.








"SCOTCHLOK" BRAND CRIMPING TOOL MODEL E-9

The light, handy "SCOTCHLOK" Brand Crimping Tools Model E-9 insures proper connector actuation every time on all 3M "SCOTCHLOK" Brand Connectors. A convenient wire cutter is also incorporated in the adjustable Model E-9B Tool.



"SCOTCHLOK" BRAND CONNECTOR-SELECTOR CHART

The design of all 3M "SCOTCHLOK" Brand Connectors allows them to be used on all known cable insulations.

"SCOTCH- LOK" Connector Type	Features	Style	Wire Size	Port Size	Application Area	Crimping Tool		"SCOTCH- LOK" Connector Type	Features	Style	Wire Size	Port Size	Application Area	Crimping Tool	
						Model	Setting							Model	Setting
 UR	Self-Stripping Self-Sealing Pre-Insulated	Pigtail	No. 19 to No. 26 Solid No. 20 to No. 24 Stranded	.068"	Ready Access Terminals Pedestal Mounts Cable Splices Branch Cable Splices Cable Pair Transfers	E-9B	S Thick Thin	 U1R	Self-Stripping Self-Sealing Pre-Insulated Full Pair	Inline	No. 19 to No. 24 Solid No. 19 to No. 22 Stranded	.125"	Splice Cases Exposed Line Drop Wire	E-9B	L Thin Thin
						E-9E	Pre-Set								
 UG	Self-Stripping Pre-Insulated Side Slot	Bridge (Tap)	No. 19 to No. 26 Solid No. 20 to No. 24 Stranded	.068"	Ready Access Terminals Pedestal Mounts Cable Splices Branch Cable Splices Cable Pair Transfers Service Shafts Loading Coils	E-9B	S Thick Thin	 U1B	Self-Stripping Self-Sealing Pre-Insulated Full Pair	Inline	No. 16 to No. 19 Solid or Stranded	.125"	Splice Cases Exposed Line Drop Wire	E-9B	L Thin Thin
						E-9E	Pre-Set	 U1Y	Self-Stripping Self-Sealing Pre-Insulated	Bridge (Tap)	No. 16 to No. 19 Solid or Stranded	.125"	Splice Cases Exposed Line Drop Wire	E-9B	L Thin Thin

ORDERING INFORMATION

Connector Type	POUCHED		BOXED	
	Connectors Per Pouch	Pouches Per Bin Pack	Connectors Per Box	Boxes Per Case
UR	20	50	100	10
UG	20	50	100	10
U1R			50	10
U1B			50	10
U1Y			50	10
Crimping Tool				
Model E-9B			Per Box	Per Case
Model E-9E			1	10
			1	10

"SCOTCHLOK" and the Plaid Design are trademarks of 3M Company.

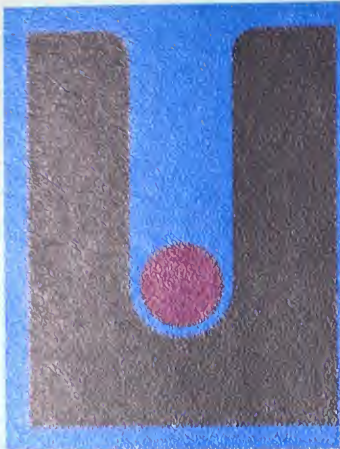
Electrical Products Division **3M**
COMPANY



Now telephone service... can be located anywhere on any surface!



IN APARTMENTS **IN HOSPITALS** **IN ANY BUILDING**

ScotchflexTM
BRAND
FLAT CABLE SYSTEM



"SCOTCHLOK" BRAND C

The design of all 3M "SCOTCHLOK"

"SCOTCH- LOK" Connector Type	Features	Style	Wire Size	Port Size
UR 	Self-Stripping Self-Sealing Pre-Insulated	Pigtail	No. 19 to No. 26 Solid No. 20 to No. 24 Stranded	.068"
UG 	Self-Stripping Pre-Insulated Side Slot	Bridge (Tap)	No. 19 to No. 26 Solid No. 20 to No. 24 Stranded	.068"

ORDERING INFORMATION

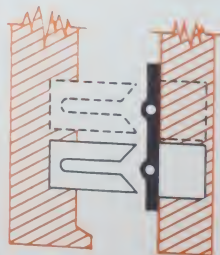
Connector Type	Connector Per Foot
UR	2
UG	2
U1R	
U1B	
U1Y	
Crimping Tool	
Model E-9B	
Model E-9E	

licity of tape with the reliability and simplicity of connections made with round wire, "SCOTCHFLEX" Flat Cable System removes many of the historical problems of station wiring. The "SCOTCHFLEX" Flat Cable System also offers a tremendous potential for increasing sales of extension telephones and, thereby, improving subscriber service.

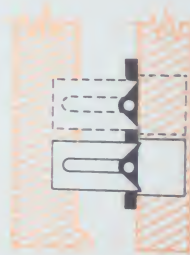
3M's unique "U-Element" connecting principle is a product of extensive research and has a proven record of reliability. (As demonstrated in the universal acceptance of "SCOTCHLOK" Brand Electrical Connector Type-UR which pioneered the "U-Element" connecting principle.)

Combining the application ease and sim-

"U-ELEMENT" CONNECTING PRINCIPLE



As the "SCOTCHFLEX" Flat Cable is placed in the channel of a "SCOTCHFLEX" component the wires are automatically aligned directly in the path of the "U-Element" Connector.



When the "U-Element" Connector is forced down it pierces and shears away the insulation from the conductor.



The "U-Element" grasps the conductor and the spring loaded metal fingers develop a high contact pressure on the conductor.

NO SURFACE DEFACING... PRACTICALLY INVISIBLE!

Now telephone installations can be placed virtually anywhere on any surface with station wire that is Practically Invisible. "SCOTCHFLEX" Brand Flat Cable System with its low "wall-hugging" silhouette blends inconspicuously into room decor.

Helps Sell Extension Telephones

Housing authorities and building managers' objections to holes, nails or staples in their walls are easily overcome by the pressure sensitive adhesive of the "SCOTCHFLEX" Flat Cable System.

Reduces Installation Costs

Fast, easy to use "SCOTCHFLEX" Flat Cable makes those "difficult" installations (ceramic or plastic tile, concrete or cinder block, porcelainized steel, plaster, dry wall, or wood grain) simple, fast and neat. Applies as easily as tape.

Reliability

The conductivity of solid, round copper conductors and the rapid, reliable connections made with round wire make the "SCOTCHFLEX" Flat Cable and components a truly reliable and versatile station wiring system. Splices, transitions, and connections are made swift and sure with the unique self-stripping "U-Element" Connecting Principle. The Flat Cable and components adhere to most surfaces with the tenacity of 3M's finest adhesive.



ScotchflexTM
BRAND
FLAT CABLE SYSTEM

When the "U-Element" Connector is forced down it pierces and shears away the insulation from the conductor.

As the "SCOTCHFLEX" Flat Cable is placed in the channel of a "SCOTCHFLEX" component the wires are automatically aligned directly in the path of the "U-Element" Connector

spring loaded metal fingers develop a high contact pressure on the conductor.



From incoming station wire the "SCOTCHFLEX" Transition Connector No. 721 takes over, making the transition from the station wire to "SCOTCHFLEX" Flat Cable No. 700. Simply press the base of the transition connector with its pressure sensitive adhesive in the desired location; place the individual station wire conductors (complete with insulation) in one end of the connector and the Flat Cable in the other end. Screw the cover in place and a highly reliable transition splice is made.

Continuing along the wall, around a doorway, across a ceiling or under a rug, "SCOTCHFLEX" Flat Cable No. 700, with its low silhouette and pressure sensitive adhesive applies as easily as tape. No holes to drill, no nails or staples to drive, no surface defacing. Also no more installation problems on ceramic tile, plastic tile, concrete blocks, plaster or wood paneling. The conductors are Round wires for connection ease and reliability.

The telephone hook-up is made with "SCOTCHFLEX" Flat Cable Terminal No. 717. The "U-Element" principle is used to connect the cord set binding screws to the Flat Cable Conductors without wire skinning or other cable preparations. The "U-Elements" in Terminal No. 717 are also cable splicing devices providing the facility to extend the run during installation or at a future date. Pressure sensitive adhesive holds the terminal securely in place.





Make a splice or tap with "SCOTCHFLEX" Flat Cable Tap Connector No. 718 in one fast step. Lay the flat cable in place, screw on the cover and the "U-Elements" make the connection.



Or install a convenient "SCOTCHFLEX" Flat Cable Jack No. 719. Place telephone outlets for customer's convenience and enhance installation appearance. "SCOTCHFLEX" Jack No. 719 with "U-Element" connectors and pressure sensitive adhesive adds a new dimension to telephone convenience. Jack No. 719 accepts any standard 4 prong telephone plug.

The "SCOTCHFLEX" Flat Cable Plug No. 722 is design matched to harmonize with the "SCOTCHFLEX" Flat Cable System.

"SCOTCHFLEX" Hand Roller Model E-14 is used to roll the Flat Cable—insuring complete contact of the Flat Cable Adhesive to the supporting surface.



When turning a corner use "SCOTCHFLEX" Flat Cable Corner Cover No. 720 to maintain the decor blending installation appearance of the "SCOTCHFLEX" Flat Cable System.

ORDERING INFORMATION

"SCOTCHFLEX" Brand Flat Cable No. 700*—4 conductor—100 ft.	Per Box	Per Ctn.	Per Case
"SCOTCHFLEX" Brand Flat Cable Terminal No. 717*	1 roll		10 rolls
"SCOTCHFLEX" Brand Flat Cable Terminal No. 717*	1 ea.	10 ea.	50 ea.
"SCOTCHFLEX" Brand Flat Cable Tap-Connector No. 718*	10 ea.		50 ea.
"SCOTCHFLEX" Brand Flat Cable Jack No. 719*	1 ea.	10 ea.	50 ea.
"SCOTCHFLEX" Brand Flat Cable Corner Cover No. 720*	10 ea.	100 ea.	500 ea.
"SCOTCHFLEX" Brand Flat Cable Transition Connector No. 721*	10 ea.		50 ea.
"SCOTCHFLEX" Brand Flat Cable Plug No. 722*	1 ea.	10 ea.	50 ea.
"SCOTCHFLEX" Brand Hand Roller Model E-14	1 ea.		10 ea.

APPLICATION

Use the "SCOTCHFLEX" Brand Flat Cable System for station wiring wherever wall composition or building restrictions cause installation or system location problems. Installation hints are included with each Hand Roller Model E-14, each carton of Flat Cable Terminals No. 717 and each carton of Flat Cable Jacks No. 719. Available in soft neutral gray, or compatible ivory, the "SCOTCHFLEX" Brand Flat Cable System blends with room colors. Where uniformity of room color is desired, all components may be painted using standard indoor paints.

*State color (Ivory or Gray) when ordering.
Please place orders with your local telephone or communications equipment distributor.



"SCOTCHFLEX" IS A TRADEMARK OF 3M CO.

International Division
P.O. BOX 3800, ST. PAUL 1, MINNESOTA

3M
COMPANY

IE-MSE-1 (341, 5) MP

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